SCIENCE ABSTRACTS

SECTION A

PHYSICS.

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L. A. Woodward, B.A., Ph.D.

A star (*) indicates that the Abstract deals with Apparatus and Instruments.

MAY, 1936.

GENERAL PHYSICS.

ADSORPTION.

1901. Formula for Total Adsorbed Substance in an Adsorption System. J. Voicu. *Kolloid Zeits.* 74. *pp.* 316–330, *March*, 1936.—The author derives a very simple mathematical formula : $T = rA_0/r_1 + rK_0/r_2$, which enables the amount T of adsorbed substance to be determined from extraction data, where r denotes the extract suitably related to the volume of the solution, and A_0, K_0, r_1 and r_2 are numerical quantities to be calculated by means of the formula itself. The exponents and coefficients of the adsorption isotherms are then determined from the equations : $x^p = A_x(1 - r)^{pq} + K$, and $\theta^p = A_0(1 - r)^{pq} + K_0$, where $p = 1 - n$, n being the exponent of the adsorption isotherm, and q is the number of extractions. The formula is applicable to every type of adsorption system and especially suitable for soil analysis. H. H. Ho.

1902. Adsorption at Air-Water Interface by the Microtome Method. J. W. McBain and R. C. Swain. *Roy. Soc., Proc.* 154*A*. *pp.* 608–623, *May* 1, 1936.—The microtome method for determining the absolute amount of adsorption in the air-water interface is shown to give definite reproducible results of moderate accuracy. In contradistinction to results for moving or dynamic surfaces, the measurements obtained for positive adsorption of phenol and of hydrocinnamic acid, and for negative adsorption of sodium chloride, on motionless or static surfaces finally agree with the prediction of the Gibbs adsorption theorem. AUTHORS.

1903. Sorption of Iodine by Polyvinyl Alcohol. W. Gallay. *Canad. J. of Research*, 14. *Sect. B. pp.* 105–113, *March*, 1936.—Iodine is taken up by polyvinyl alcohol from aqueous solution according to the adsorption isotherm. From aqueous methyl and ethyl alcohol solutions, the sorption obeys Henry's law. One electrolyte measured was absorbed by the colloid. The relation of Kroeker between weight of adsorbent and sorption of adsorbate, keeping total adsorbate constant, holds only at higher concentrations of adsorbent. Pre-absorption of an electrolyte does not materially affect adsorption of iodine by polyvinyl alcohol. The nature of the blue polyvinyl alcohol-iodine complex is discussed. AUTHOR.

1904. Sorption of Gases and Vapours by Aerosols. A. Krassilschikow. *Kolloid Zeits.* 74. *pp.* 138–147, *Feb.*, 1936.—The procedure adopted, proposed by S. Wosnessensky, for the determination of gas sorption by aerosol particles is described. The method depends on the difference in diffusion of gases in the presence and absence of aerosol particles. It is shown, by a determination of the sorption of Br_2 by mineral oil—aerosol particles, that with increase in aerosol concentration there is at the same time an increase in the gas amount. An explanation of this phenomenon is suggested. The isotherms of Br_2 sorption by aerosol particles of NH_4Cl reach a maximum, so that with increase in gas concentration the sorption decreases. J. K.

1905. Gas-Solid Equilibria. Part VI. Adsorption from Binary Gas Mixtures by Silica Gel. B. Lambert and H. S. Heaven. *Roy. Soc., Proc.* 153*A*. *pp.* 584–600, *Feb.* 1, 1936.—Previous experimental technique gained in connection with pressure-concentration equilibria

between adsorbent solids and binary gas mixtures is made use of and simplified in the present study [see Abstract 1375 (1934)]. The adsorption by silica gel at 0° C. from O_2–A, O_2–N_2 and O_2–He is studied, equal proportions of the two gases being present in every case. With O_2–A mixtures the composition of the adsorbed phase is greatly affected by the order in which the two gases reach the gel surface, which results are shown to be incompatible with a monomolecular adsorbed phase. A theory of adsorption is described based on the assumption that an adsorbed phase consists of two layers of gas molecules. J. K.

1906. Adsorption of Gases on Sodium Chloride. F. C. Tompkins. *Faraday Soc., Trans.* 32. *pp.* 643–653, *April*, 1936.—The adsorption of 10 gases on NaCl crystals at low temperatures and pressures is investigated. The surface is very sensitive to impurities and to variations in the conditions of outgassing. Dipole gases are highly adsorbed according to the value of their electric moment; there is a parallelism between the adsorbability of non-polar gases and their polarisability. The shape of the isotherms are qualitatively explained by assuming that there are forces operating between adsorbed molecules. Association of NO occurs in the surface layer, and CO_2 lies flat on the surface when adsorbed. The heats of adsorption of A and CH_4 and CO in the temperature range — 183° C.-— 192° C. are much smaller than anticipated from theoretical considerations. There is no lateral diffusion of adsorbed molecules at — 192° C. or at — 183° C., but a slow secondary adsorption is found at — 78·2° C.

AUTHOR.

1907. Structure of Adsorption Complexes of Clays. R. H. J. Roborgh and N. H. Kolkmeijer. *Zeits. f. Krist.* 94. *pp.* 74–79, *April*, 1936.—From the similarity in base-exchange behaviour of clays of differing character and the fact that this depends rather on the total surface of the constituent particles than on their mass, and other reasons, it is inferred that this depends on a thin surface film produced by the hydrolising action of soil solutions on the clay constituents, and which is identical on all clay materials provided climatic conditions are not violently different. This is confirmed by the fact that X-ray examination before and after extraction of the clay with HCl,aq. (which removes this film) shows the lines attributable to the clay particles much sharper after extraction, but otherwise unchanged, while the blackening of the background due to a highly disperse material with no lattice structure tends to disappear showing that this surface film is of the nature of an Al-Fe-Si gel. The same increased sharpness in the lines results from drying the clay in a vacuum. C. A. S.

See also Abstracts 2095, 2459.

ATOMIC AND MOLECULAR STRUCTURE.

1908. Nuclear Theory. P. Jordan. *Naturwiss.* 24. *pp.* 209–215, *April* 3, 1936.—Recent developments in nuclear theory are examined critically and correlated. The nature of the fundamental particles is discussed and the existence of two kinds of neutron with opposite but equal spin and magnetic moments is suggested. J. E. R. C.

1909. Atomic Physics. N. Feather. *Phys. Soc., Reports*, 2. *pp.* 74–96, 1935.

1910. Radiations Emitted from Artificially Produced Radioactive Substances. Part I. Upper Limits and Shapes of the β-Ray Spectra from Several Elements. F. N. D. Kurie, J. R. Richardson and H. C. Paxton. *Phys. Rev.* 49. *pp.* 368–381, *March* 1, 1936.—

The β-ray spectra of N^{13}, F^{17}, Na^{24}, Si^{31}, P^{32}, Cl, A^{41} and K^{42} are investigated by measuring the curvatures of the tracks due to the β-rays in a cloud chamber traversed by a known magnetic field. The shapes of the curves are in good accord with the Konopinski-Uhlenbeck modification of the Fermi theory for the first 5 elements. The spectra of the last three elements can be resolved into two components, each of which has a shape which fits the theory. The theory always indicates a higher upper limit than is found by inspection of the data, because of the high order of contact which it demands with the momentum axis. In the case of N^{13} an upper limit is found at 1·45 eMV by fitting the data with a theoretical curve. The upper limit of N^{13} calculated from known reaction energies is 1·5 eMV so the agreement is excellent. F. C. C.

1911. Artificial α-Radioactivity. R. Döpel. *Zeits. f. Physik*, 99. 3–4. *pp.* 161–168, 1936.—The emission of α- and H-particles in natural and artificial radioactive processes is discussed from the point of view of Gamows' theory. The author attempts to detect artificial α-radioactivity in the case of a large number of elements. The elements are bombarded by neutrons from a Rn-Be source and the scintillation method is used to detect the α-particles. The experiments indicate that the emission of α-particles after the removal of the neutron source may occur in the case of In, Ce and Cs, but owing to the small intensity of the neutron source, this could be definitely established. W. E. P.

1912. Nuclear Chemistry. M. Magat. *R.G.E.* 39. *pp.* 373–381, *March* 14, 1936.—A general exposition, with special reference to the recent work of Chadwick and of Curie and Joliot, on the present position of the problem of nuclear structure, the constitution of matter, and artificial transmutation of the elements. N. M. B.

1913. Rôle of Chemistry in the Study of Atomic Transmutation. F. A. Paneth. *Nature*, 137. *pp.* 560–562, *April* 4, 1936.—The author discusses the importance of a combination of physical and chemical methods in the investigation of transmutation processes, as illustrated by the discovery of Ra and Po, the formation of He in α-ray emission, of radon from Ra solution, and the identification of Ra-*D* from radon. Radiochemical methods could not, however, be used in the large number of transmutations due to α-ray bombardment when only stable atoms were formed, but this has now been changed since the discovery of the artificial radio-elements ; *e.g.* the formation by α-rays of N from B and P from Al, and the work of Fermi on transmutation by neutron bombardment. Other instances mentioned of the chemical study of more complex artificial disintegrations are the series of radio-elements built up by bombardment of Th, the supposed transmutation ${}^{38}_{17}Cl \rightarrow {}^{38}_{18}A \rightarrow {}^{34}_{16}S$, and the apparent formation by neutron bombardment of U of elements of higher atomic number than 92. Finally, following the reaction ${}^{9}_{4}Be + {}^{4}_{2}He \rightarrow {}^{1}_{0}n + {}^{12}_{6}C$, the neutrons, after slowing down by collision with H nuclei, can be used up almost quantitatively by the reaction ${}^{10}_{5}B + {}^{1}_{0}n \rightarrow {}^{4}_{2}He + {}^{7}_{3}Li$, and the microchemical detection and measurement of traces of He can be easily carried out. N. M. B.

1914. Radioactive Sulphur Isotope. E. B. Andersen. *Zeits. f. phys. Chem.* 32. *Abt.B.* 3. *pp.* 237–242, 1936.—By bombarding Cl in the form of CCl_4 with neutrons (obtained from Be and Rn) the author has been able to produce a radioactive form of S. The following equation is suggested to explain the reaction, ${}_{17}Cl^{x} + {}_{0}n^{1} \rightarrow {}_{16}S^{x} + {}_{1}H^{1}$. The isotope has a period of about 80 days, and hence is very suitable for tracing the

transfer of S in chemical reactions. It has been used in this way in establishing a number of reactions. J. E. R. C.

1915. Relative Position of Resonance Levels for Neutron Capture by Silver and Iodine. P. Preiswerk and H. v. Halban, Jr. *Comptes Rendus*, 202. *pp.* 840–842, *March* 9, 1936.—Neutrons from Ra + Be surrounded by paraffin were passed through seven sheets of paraffin, each 3–4 mm. thick and separated by air gaps, and then, after being filtered through a sheet of Cd placed after the seventh sheet were allowed to fall on an indicator of I or Ag. A sheet of Ag (0·3g./cm^2.) or I (3g./cm.) was placed between the last paraffin sheet and the Cd or between various pairs of paraffin sheets, and the absorption plotted against the thickness of paraffin traversed by measuring the amount of radio-Ag (22 sec.) or radio-I formed. With Ag as absorbent and Ag or I as indicator absorption steadily increases with thickness of paraffin as also with absorbent and indicator both I, but with I as absorbent and Ag as indicator absorption at first increases, attains a maximum and then decreases, showing that the energy of the resonance level of I is greater than that of the resonance level of that isotope of Ag which forms radio-Ag (22 sec.). Combining these results with those of Amaldi and Fermi (*La Ricerca Scientifica*, 2. *p.* 544, 1935) the energies of their resonance levels decrease in the order Br, I, Ag, In, Rb, Ir. C. A. S.

1916. Capture of Slow Neutrons. G. Breit and E. Wigner. *Phys. Rev.* 49. *pp.* 519–531, *April* 1, 1936.—Current theories indicate that as a consequence of the large cross-section presented by some nuclei to slow neutrons a large scattering is to be expected. This is not observed, however, and the authors endeavour to explain this by assuming that at a collision a nuclear particle as well as the captured neutron is raised to an excited state. The resonance levels are broadened by γ-ray emission, the scattering being thereby reduced in comparison with the absorption. The absorption decreases with increase in height of the resonance, the cross-section being 10^{-19} cm^2. for a 50-V neutron, but $0{\cdot}5 \times 10^{-20}$ cm^2. for a neutron having average thermal energy. The estimated probability of a low energy nuclear level supports the hypothesis. J. E. R. C.

1917. Electron-Neutron Interaction. E. U. Condon. *Phys. Rev.* 49. *pp.* 459–461, *March* 15, 1936.—Assuming a possible short-range interaction between electrons and neutrons of the form $V = K\delta(r_N - r_e)$ where δ is the Dirac delta function and r_N and r_e are the vector positions of electron and neutron, respectively, it is shown that probably $|K| < 30mc^2 (e^2/mc^2)^3$ from consideration of the effect of the interaction on slow neutron scattering cross-sections. If K is positive and a little less than this upper limit this interaction could be responsible for the observed isotope displacement of spectral energy levels. AUTHOR.

1918. Selective Absorption Regions of Slow Neutrons. D. F. Weekes, M. S. Livingston, and H. A. Bethe. *Phys. Rev.* 49. *pp.* 471–473, *March* 15, 1936.—A method is described for measuring energies of neutrons outside the thermal energy range, but in the range demanded by the Wigner-Breit resonance theory of selective absorption. The arrangement consists of (1) a detector (*e.g.* Ag), for which the resonance level is to be determined, activated by a source of slow neutrons; (2) the same with B absorber interposed; (3) with Cd absorber but without B; (4) with both Cd and B absorbers. The measured activities represented by the differences expressed in the ratio (1) − (3)/(2) − (4) give the

absorption coefficient of B for thermal neutrons, and (3)/(4) gives the absorption coefficient in B for the resonance neutrons to be determined.
N. M. B.

1919. Diffraction of Slow Neutrons by Crystalline Substances. W. M. Elsasser. *Comptes Rendus*, 202. *pp.* 1029–1030, *March* 23, 1936.—Noting that the wave-length of a slow neutron having average thermal energy is of the same order as the grating constant of common crystalline substances the author calculates the magnitude of the diffraction effect which is to be expected when a pencil of slow neutrons falls on a crystalline powder. For the purposes of this calculation he assumes that the effect produced by a neutron will be inversely proportional to its velocity. A critical angle is predicted being 26°, 26° and 25° for Fe, Ni and Cu respectively. It is announced that preliminary experiments have detected this phenomenon. J. E. R. C.

1920. Interpretation of the Fission Rule for Olefines and Radicals. O. Schmidt. *Zeits. f. Elektrochem.* 42. *pp.* 175–184, *April*, 1936.—This paper is a contribution to the theory of homopolar valency. The subject is first briefly reviewed, and then the various rules dealing with valency fission and with free radicals are discussed. Following the above are sections dealing with the zero-point energy of the B-electrons, with impact conditions and the energy content of the B-electrons, with the outstanding significance of the principle of spin distribution, and finally with deductions from the theory. The treatment by Fermi statistical methods is employed throughout, and in particular the relationships between zero-point energy and electronic density, since these problems are better treated in this manner than by the conceptions of wave-mechanics which ignore the idea of spin. A picture is suggested for the union of two hydrogen atoms by which the Fermi methods are shown to be superior for this particular problem, and by which the fission rule can find adequate interpretation. Paraffins and olefines are then investigated. H. H. Ho.

1921. Calculation of Number of Isomers of Organic Compounds. G. Pólya. *Zeits. f. Krist.* 93. 6. *pp.* 415–443, *March*, 1936.—The number of possible structural isomers of compounds such as the derivatives of benzene, naphthalene and similar fundamental substances, are determined algebraically. The principal advantage of this process is that while chemical theory leads to positive methods for adducing the number of possible structural isomers, the present method is useful for tabular compilation. The central element of the method is the symmetry form of the fundamental substance which is easy to determine, and thereby enables an algebraical expression for exchange possibilities to be deduced. The argument is illustrated by numerous examples, in which advanced mathematical knowledge is avoided. Further examples with respect to stereoisomerism are also included. In the tabular section of the paper the isomers for the simpler organic compounds are grouped, and the most important formulæ collected together. H. H. Ho.

1922. Molecular Clustering in Liquid Fatty Acids. R. S. Krishnan. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 126–134, *Feb.*, 1936.—The variations in intensity and depolarisation factor of the transversely scattered light is studied in detail in the case of formic, acetic, propionic and normal butyric acids, with the incident light unpolarised, horizontally and vertically polarised. In the case of formic and acetic acids at room-temperature the depolarisation factor ρ_h is found to be about 90 % when the incident light is polarised with vibrations horizontal. This observation

furnishes for the first time definite experimental evidence for the existence of large molecular aggregates in these highly associated liquids, of size not small compared with the wave-length of light. ρ_h increases with rise in temperature and at about 90° C. it attains its limiting value of 100 % in these two acids. The intensity of scattering also at first diminishes with rise in temperature in these two cases, contrary to the molecular theory of light scattering. It is shown that molecular association is distinctly the cause for the extraordinary behaviour of formic and acetic acids in the initial stages. Propionic and normal butyric acids do not show such anomalies. [See Abstracts 3851 and 4781 (1935).] AUTHOR.

1923. Relative Atomic Weight of Oxygen in Water and in Air. M. Dole. *J. Chem. Phys.* 4. *pp.* 268–275, *April*, 1936.—A difference in the density of water made from atmospheric oxygen plus tank hydrogen and aqueous oxygen plus tank hydrogen is interpreted as indicating that the atomic weight of oxygen in the air is 0·000108 atomic weight units heavier than the oxygen of Lake Michigan water. This observation finds experimental confirmation in the work of several other investigators and can be applied in certain cases to the reinterpretation of already existing data, clarifying several anomalous and inexplicable effects. The difference in atomic weights can be accounted for quantitatively by assuming that an isotopic exchange equilibrium of the type discussed by Urey and Greiff occurs at a temperature of − 50° C. in the lower regions of the stratosphere. The distribution of oxygen isotopes in the atmosphere is calculated by means of the usual hypsometric equation, but the separation due to gravity is not sufficient to explain quantitatively the excess atomic weight of atmospheric oxygen. The chemical and physical standards of atomic weights are discussed and the proposal is made that a single standard based on the mass of a pure isotope such as protium be adopted.

AUTHOR.

1924. Calculation of Atomic Weights from Nuclear Reaction Energies. H. A. Wilson. *Roy. Soc., Proc.* 154*A*. *pp.* 560–563, *May* 1, 1936.—It is shown that atomic weights with $O^{16} = 16$ can be calculated from nuclear reaction energies without making any use of atomic weights obtained by other methods. The atomic weights of 18 light elements are calculated in this way and the values obtained are nearly equal to those of Bethe and of Oliphant, Kempton, and Rutherford which were obtained from mass-spectrograph results corrected by means of nuclear reaction energies. AUTHOR.

1925. Molecular Volume of Normal Liquids. R. Lautié. *Comptes Rendus*, 202. *pp.* 753–754, *March* 2, 1936.—The formula previously deduced [see Abstract 1334 (1935)] is transformed into $T_c/(T_c - T_e)\cdot\log\{24(T_c - T_e)/V_e\} = K'$, where K′ is usually $= 2\cdot9 - 3\cdot1$. As the validity of the formula depends, however, on the theory of corresponding states, it does not hold for polymerised liquids, such as H_2O or EtOH, or for such as are of very low molecular weight (*e.g.* H_2) or contain very few atoms in the molecule as O_2, N_2, A, etc. It does hold for most liquids for which the critical temperature exceeds 300°. C. A. S.

1926. Distribution of Molecular Weight in Highly Polymerised Mixtures. G. V. Schulz. *Zeits. f. phys. Chem.* 32. *Abt.B.* 1. *pp.* 27–45. 1936.—The evaluation of the distribution function is necessary for the complete quantitative study of the variation of the molecular weight in highly polymerised mixtures, and this is now found in relation to the mean molecular weight. When the distribution function is known, then

the deviation of the viscosimetric average molecular weight of a mixture can be calculated from the mean molecular weight. The distribution function is evaluated for three high-molecular substances (*viz.*, the fraction of a polystyrol according to the experiments of Signer and Gross, an unfractionated polymeric mixture, and a nitrocellulose obtained by a new fractionation method), and the deviation of the viscosimetric from the mean molecular weight calculated. The viscosimetric method for the determination of molecular weights is valid so long as the substances do not attain a high delivery. The distribution function of a synthetic product (poly-isobutylene) is so much different from that of a natural substance (cellulose), that the mode of creation of the plant cellulose must be fundamentally different from that of the synthetic high molecular product.

H. H. Ho.

See also Abstracts 1958, 2011, 2057, 2170, 2191, 2219, 2236, 2239, 2305, 2333, 2371, 2419.

COLLOIDS.

1927. Effectiveness of Collision of Aerosol Particles against Solid Walls. N. Fuchs. *Acta Physicochimica*, 3. 6. *pp.* 819–826, 1936. *In German.*—An arrangement of an ultramicroscope is described which permits observations to be made on the collision of suspended particles with a wall and with each other. Although a certain percentage (10–25 %) of the collisions appear to be non-effective (the particles rebound from the wall), nevertheless, from theoretical considerations and from a comparison of the behaviour of different aerosols and walls, it is suggested that the non-effectiveness is only apparent. The difference in the named percentage is governed by electrical forces. J. K.

1928. Stability and Charge of Aerosols. Part II. N. Fuchs and I. Petrjanow. *Acta Physicochimica*, 3. 6. *pp.* 827–838, 1936.—A method is described for the preparation of pure, unipolar, highly-charged aerosols. Oil mists obtained by this method, as is to be expected from theoretical considerations, are very unstable ; they are easily scattered by a spatial charge and precipitation takes place on the walls of the chamber. A large bipolar charging of the oil mists is found moreover to exert no influence on their stability. [See Abstract 3471 (1934)]. J. K.

1929. Thorium Phosphate Gels. M. U. Parmar, S. M. Mehta and M. Prasad. *Indian Acad. Sci., Proc.* 3*A. pp.* 107–118, *Feb.*, 1936.—Reference is made to the work of S. Prakash, who, in 1929, first prepared thorium phosphate gels by directly mixing solutions of thorium nitrate and potassium phosphate. The authors have found that thorium phosphate gels can be easily prepared by using phosphoric acid instead of potassium phosphate. The slight precipitate obtained on mixing solutions of thorium nitrate and phosphoric acid quickly disappears on shaking to form a clear solution which sets to a transparent gel. The factors which affect the time of setting of these gels are investigated as, *e.g.*, the H-ion concentration, temperature, and the addition of extra amounts of electrolytes and non-electrolytes to the gel-forming mixtures. J. K.

1930. Thixotropic Gelation. Part I. J. L. Russell and E. K. Rideal. Part II. J. L. Russell. *Roy. Soc., Proc.* 154*A. pp.* 540–560, *May* 1, 1936.—Part I. Thixotropic gels are prepared by the addition of small amounts of alumina to silica suspensions. One part of alumina to 4000 of relatively coarse quartz particles is sufficient to

produce gelation. With larger amounts of alumina the increase in volume of the gel is directly proportional to the weight of alumina added. The possible mechanisms of gel-formation are discussed. The theory proposed is that thixotropic gelation is due to orientated coagulation of the colloidal material, or of some part of it. Part II. Moderately strong clay suspensions undergo three different types of coagulation, designated by A, B, and C, and occur at low, medium, and high electrolyte concentrations respectively. Type A is a partial flocculation and of a somewhat lyophobic character. Type B is thixotropic gelation. Type C is complete flocculation of a definitely lyophilic character. The properties of the suspensions indicate that the clay consists partly of a highly dispersed gel-forming material and partly of a coarser material without any marked capacity for gelation. The colloidal properties of each constituent are influenced to some extent by the presence of the other. The apparent viscosity of the thixotropic clay gels is found to vary inversely as the cube of the applied stress. The gels show a well-defined breaking point if stretched beyond a certain limit. There is no evidence of permanent rigidity at low stresses. AUTHORS.

1931. X-Ray Study of Amorphous Rubber. G. L. Simard and B. E. Warren. *Am. Chem. Soc., J.* 58. *pp.* 507–509, *March,* 1936.—The density of surrounding atoms in unstretched rubber is determined by a Fourier analysis of the X-ray scattering curve. The resulting distribution curve is in good agreement with the usual picture of rubber as comprised of long chain molecules. It is concluded that but little information can be obtained as to the configuration of the chains in unstretched rubber.

AUTHORS.

*1932. **Emulsifying Machine. R. Auerbach.** *Kolloid Zeits.* 74. *pp.* 285–287, *March,* 1936.—A new machine is described in which there is complete separation between the mechanism for moving the dispersing agent and that for bringing about the dispersion. J. K.

1933. Dispersed Gases. Part I. Thermodynamics and Formation. R. Auerbach. *Kolloid Zeits.* 74. *pp.* 129–138, *Feb.,* 1936.—A few thermodynamic relations are given for capillary pressure in dispersed gases. A new process is described for the preparation of dispersed gases in fluids, which does not depend as formerly upon the mechanical subdivision of gases introduced under normal or super pressure ; on the contrary, the new process is carried out under strongly diminished total or partial pressures. After the dispersion the disperse system produced is again brought to atmospheric pressure, which together with the capillary pressure compresses the gas bubbles, thus leading to an increase in the degree of dispersion. The dispersing process can be carried out in one or several operations.

J. K.

1934. Crystalline Structure and Physico-Chemical Properties in the Colloidal State. S. S. Bhatnagar. *Current Science,* 4. *pp.* 570–571, *Feb.,* 1936.—A short review on controversies regarding the behaviour of colloids, mentioning *inter alia* the work of P. P. von Weimarn, Pennycuick's work on colloidal Pt and films of impurities, the work of Kohlschutter on Ag sols, the earlier work on the yellow and red oxides of Pb including Applebey and Reid's later work on this subject. It is suggested that an examination of some of the physical properties of colloidal systems such as the peizoelectrical behaviour in gels and the thermal and electrical conductivities of sols and gels will lead to important results. J. K.

1935. Mechanism of Coagulation by Ultrasonic Waves. K. Söllner and C. Bondy. *Faraday Soc., Trans.*, 32. *pp.* 616–623, *April*, 1936.—Ultrasonic waves display a strong coagulation action in emulsions and suspensions. "Radiation pressure" increases the rate of spontaneous coagulation by a kind of orthokinetic coagulation. The locus of coagulation in aqueous mercury emulsions can be readily separated from that of emulsification; coagulation proceeds in the interior of the aqueous phase, while emulsification proceeds at the interface of large bulks of metal and water. In aqueous emulsions of organic liquids this separation cannot be so easily effected. Coagulation by ultrasonics in unstable suspensions is due to the same causes as in emulsions. It is also stated that the rate of accumulation at nodes or antinodes depends strongly on the particle-size and in aqueous systems, particles less dense than the medium of dispersion are accumulated at the nodes, denser ones at the antinodes. [See Abstract 1414 (1936).] J. K.

See also Abstracts 1907, 1926, 2049, 2050, 2051, 2052, 2158, 2312, 2393, 2462.

CRYSTAL STRUCTURE AND PROPERTIES.

1936. Reciprocal Lattice in Crystal Structure Theory. P. P. Ewald. *Zeits. f. Krist.* 93. 5. *pp.* 396–398, *March*, 1936.—An account of the relative shares in the theory of the reciprocal lattice of the author and v. Laue, with some suggestions for change in notation. C. A. S.

1937. Effective Radii of Atoms and Ions in Crystals. Part II. E. Herlinger. *Zeits. f. Krist*, 93. 5. *pp.* 399–408, *March*, 1936.—The outer shells and the valence electrons contribute most to the radii. [For Part I see Abstract 1503 (1932).] F. I. G. R.

1938. Calculation of Laue Patterns from Plastically Bent Crystals of NaCl. A. Komar. *Zeits. f. Krist.* 94. *pp.* 22–32, *April*, 1936. *In English. Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 97–99, 1936. *In English.* By making assumptions as to the rotation of the slip planes in plastically deformed crystals, a graphic-analytical method for constructing Laue patterns of bent crystals of rock-salt is developed. The predictions of this theory show quantitative agreement with the experimental measurements. Author.

1939. Distribution of Polar Distances in Crystals of Average Syngonics. I. I. Schafranowski. *Zeits. f. Krist.* 94. *pp.* 33–39, *April*, 1936.—A number of graphs illustrate the relation between polar distances and the corresponding number of forms. The method is applied to the trigonal, tetragonal, and hexagonal systems. F. I. G. R.

1940. Van der Waals Potentials and Lattice Energy of a n-CH_2 Chain Molecule in a Paraffin Crystal. A. Müller. *Roy. Soc., Proc.* 154*A*. *pp.* 624–639, *May* 1, 1936.—The van der Waals potential of a CH_2 group in a paraffin crystal is calculated with the aid of the theory developed by London. The calculation necessitates the dividing of the molecules into small units. The size of these units is arbitrary to a certain extent, but it is found that the mode of division does not affect the result to a great extent. The observed value of the sublimation energy is found to lie between the two calculated values obtained with different modes of division. Use is made of the susceptibilities and polarisation of the C and H atoms in the calculation of the energy. Author.

1941. Recrystallisation Phenomena. A. E. van Arkel. *Rev. de Mét.* 33. *pp.* 197–202, *March*, 1936.—A brief account is given of the results derived from X-ray measurements of the crystal structure of metals before

and after flow has occurred. After deformation, the crystal is in a state of greater strain and hence tends to be unstable ; heating tends to restore the crystal to its normal state. The rate of recrystallisation is a function of the deformation of the metal and of the temperature. The secondary recrystallisation of Al is described, and a number of interesting problems in connection with it are put forward. H. J. H. S.

1942. Allotropy of Very Pure Calcium. A. Schulze. *Zeits. f. Metallkunde*, 28. *pp.* 55–57, *March*, 1936.—From measurements of electrical resistance and thermal expansion, together with X-ray investigation, it is concluded that Ca undergoes two allotropic changes. The α-β change occurs at about 300° C., and the β-γ change occurs at about 450° C. The investigation is made on very pure Ca, which has been sublimed many times. The purity is 99·9 %. J. T.

1943. Beilby Layer. G. I. Finch and A. G. Quarrell. *Nature*, 137. *pp.* 516–519, *March* 28, 1936.—An account is given of some of the early work on polish. After a large number of experiments, Beilby concluded that polish was the result of a flowing of the material whereby the surface became coated with an amorphous layer. He also postulated the formation of an amorphous layer whenever 2 crystal faces were rubbed together, and in this way explained the hardening of metals by cold work. The latter postulate has often been criticised. Recent work on the nature of the polish layer by the method of electron diffraction is summarised ; the results described include those of Thomson, French, Randall and Rooksby, Germer, Kirchner, Raether, Darbyshire and Dixit and Miwa. The authors then describe their work ; they show that the polish layer is capable of dissolving crystals of a foreign metal at room-temperature. After a critical survey of their own and previous work they conclude that the evidence in support of Beilby's conception of the vitreous nature of the polish layer seems conclusive. A brief mention is made of the depth of the Beilby layer. H. J. H. S.

1944. Surface Structure of Polished Cleavage Faces of Calcite. H. G. Hopkins. *Phil. Mag.* 21. *pp.* 820–829, *April*, 1936.—Investigations of the nature of the structure of polished surfaces are extended to the study of calcite using the electron optical technique. [See Abstract 4074 (1935).] It is found that the polished cleavage face is crystalline, the polishing breaking up the surface into small blocks making small angles with each other. Experiments on the effects of etching the surface indicate that the action of etching, even with very dilute acids, is essentially one of pitting. Although Kikuchi lines occur at only 200 Å below the surface it seems that the polishing effect must extend to a depth of 6000 Å, as at this depth a twinned layer was observed, due presumably to working the surface. C. J. B. C.

1945. Effect of Heat Treatment on the Crystal Structure of Gold- and Silver-Leaf. G. D. Preston and L. L. Bircumshaw. *Phil. Mag.* 21. *pp.* 713–727, *April*, 1936.—Gold leaf is shown by electron diffraction to possess a preferred orientation with a cube face parallel to the surface $\pm$ 20 %. On heating in air a contraction, up to 30 %, sets in at about 350° C., accompanied by opacity due to recrystallisation, this temperature being well above the annealing temperature for cold-worked massive gold. On heating in H_2 or *in vacuo* the change is almost completely inhibited even at higher temperatures up to 700° C., and recrystallisation is now at random. No direct evidence of an oxide film can be obtained, and it is suggested that formation and simultaneous decomposition of an unstable

oxide results in a very thin superficial layer of gold recrystallised in a preferred orientation. This is found to be a (111) face parallel to the surface and confirms previous microscopical observations on sputtered films. Penetration of the oxide can take place only to a minute depth, otherwise the hammered structure would disappear immediately. With silver-leaf similar phenomena are observed, but crystal growth alone takes place, without reorientation. After heating in H_2, the diffraction photograph shows no difference from the original. It is suggested that "extra" rings, frequently observed in the spectra, are due to amalgams formed by contamination with Hg vapour. D. R. H.

1946. Crystal Structure of Cupric Ammonium Bromide. A. Silberstein. *Comptes Rendus*, 202. *pp.* 1196–1197, *March* 30, 1936.—In continuation of previous work [see Abstract 395 (1936)], the following atomic distances are given: in $(NH_4)_2CuBr_4$, Cu-Br = 2·46 and 3·14 Å, Cu-O = 2·20; in $(NH_4)CuCl_4$, Cu-Cl = 2·326 and 3·00, Cu-O = 1·99. The H_2O enters the constitution of the complex. C. A. S.

1947. Changes in Ionic Distances in Hydroxide Layer Lattices. W. Lotmar and W. Feitknecht. *Zeits. f. Krist.* 93. 5. *pp.* 368–378, *March*, 1936.—Measurements of cell size in mixed crystals of $Zn(OH)_2$, with the hydroxides of Ni and Co lead to a value of about 3·19 Å for the *a*-axis, and a C-6-type, which should not exist. Basic salts derived from C-6 hydroxides are taken to show increasing *a*-contraction, as the result of these observations. F. I. G. R.

1948. Rotation of Perchlorate Group in Crystal Lattice. C. Finbak and O. Hassel. *Zeits. f. phys. Chem.* 32. *Abt.B.* 2. *pp.* 130–134, 1936.—The high temperature structures of the perchlorates of Na, K and NH_4 are discussed in the light of new powder diagrams. Neither the structure of Herrmann and Ilge nor that of Braekken and Harang is satisfactory, and an attempt is made to develop more exact ideas regarding the rotation of the ClO_4 group in the structures of the above compounds. J. T.

1949. Structure of Heteropolyacids and Their Salts. Part II. Silicotungstates of Trivalent Metals. O. Kraus. *Zeits. f. Krist.* 93. 5. *pp.* 379–395, *March*, 1936.—The silicotungstates formulated by Marignac and Wyrouboff as $M^{III}_4(SiW_{12}O_{40})_3 \cdot nH_2O$ (M = Al, Fe, Cr; n = 87 and 93) are really $M^{III}H(SiW_{12}O_{40}) \cdot mH_2O$ (m = 28 and 30). In addition two new silicotungstates with M = Fe and Cr and m = 24 have been obtained.

	M	m	a (Å)	α	d	Mols. in unit cell.	Space Group.
I	Al	28	16·45	56°18′	3·94	2	D^5_{3d}
II	Fe	28	16·46	56°30′	3·96	2	
III	Cr	28	16·47	56°14′	3·99	2	
IV	Fe	24	15·96	58°32″	—	—	
V	Cr	24	15·98	58°32′	3·97	—	
VI	Fe	30	23·10	—	—	8	O^7_h

I–V are isomorphous; III and V usually crystallise together, the two compounds forming very thin alternate laminæ. IV was only once

obtained. VI is isomorphous with $H_3PW_{12}O_{40}\cdot 30H_2O$ [see Abstract 1290 (1933)], and closely resembles Marignac's $Al_4(SiW_{12}O_{40})_3\cdot 93H_2O$, which could not be obtained, but Marignac's analysis of which agrees better with the formula $AlH(SiW_{12}O_{40})\cdot 30H_2O$. [For Part I see Abstract 4076 (1935).] C. A. S.

1950. Crystallography of Magnesium, Cobalt and Nickel Sulphites. H. A. Klasens, W. G. Perdok and P. Terpstra. *Zeits. f. Krist.* 94. *pp.* 1–6, *April*, 1936. *In English.*—The crystals of all three compounds, $MeSO_3\cdot 6H_2O$ (Me = Mg, Co and Ni) are hemimorphic trigonal, and form star-shaped twins. The space group is C_3^4, with (for Me = Mg) a 8·820, c 9·052, α 96°20′, d 1·725; (Me = Co) a 8·822, c 9·040, α 96°22′, d 2·011; and (Me = Ni) a 8·773, c 9·013 Å, α 96°18′, d 2·027. The six H_2O surround the metal atom octahedrally, Me-O = 1·4 Å, an SO_3 group is between each pair of these octahedra that are vertically above each other, for which there is just space according to previous determinations of the structure of SO_3 [see Abstract 2930 (1931)]. This structure also explains the hemimorphism. C. A. S.

1951. Structure of Magnesium and Nickel Antimonates. J. Beintema. *K. Akad. Amsterdam, Proc.* **39.** 2. *pp.* 241–252, 1936. *In English.*—The structure of these antimonates $Me(SbO_3)_2\cdot 12H_2O$, is shown to be expressed by the formula $[Me(H_2O)_6]\,[Sb(OH)_6]_2$. The crystals are somewhat badly formed hexagonal prisms the unit cell of the Mg and Ni compounds having respectively a $16\cdot07_9$ Å, c 9·84 and a $16\cdot01_9$, c $9\cdot76_8$, d $2\cdot59_8$ and $2\cdot77_1$, 2 mols. in unit cell, space group D_3^1d. Each Sb atom is surrounded by 6(OH), and each Mg (or Ni) atom by 6 H_2O mols. The Sb atoms form layers alternating with layers of Mg (or Ni) and Sb atoms in the ratio 2Me : 1Sb so arranged that each Mg (or Ni) atom is surrounded by 6Sb atoms. C. A. S.

1952. Structure of Ice III. R. L. McFarlan. *J. Chem. Phys.* 4. *pp.* 253–259, *April*, 1936.—Ice III was prepared by subjecting liquid H_2O to 2,500 atoms and then lowering the temperature. To bring it to ordinary pressure it is passed through the ice II region, as it can be undercooled by −70°. To eliminate the result of any ice II formed X-ray examination was made of untreated crystals and of crystals powdered under liquid air. Ice III is orthorhombic a 10·20, b 5·87, c 7·17 Å, 16 mols. in unit cell, space group V_h^{26}–*Ibam*, d 1·105. The lattice is probably ionic, each O ion being surrounded by a distorted tetrahedron of O ions. The H ions probably lie midway along lines joining an O ion to its nearest neighbours. The density increase is almost entirely due to O rearrangement. X-ray photographs of ice V indicate two different structures, which, as also those of ices IV and VI, indicate a decrease in symmetry as the temperature of stability decreases. The mechanism and latent heats of the transitions are discussed. [See Abstracts 393 and 992 (1936).] C. A. S.

1953. Crystal Structure of Chlorine. W. H. Keesom and K. W. Taconis. *K. Onnes Lab., Leiden, Comm. No.* 240*e*. *Physica*, 3. *pp.* 237–242, *April*, 1936. *In English.*—The crystal structure of chlorine at −185°C. is determined with the X-ray goniometer. A tetragonal lattice is found with a = 8·56 Å and c = 6·12 Å; density 2·09 with 8 molecules per unit cell. The intensities of the Debye-Scherrer lines measured by Köhler agree with the space group D_{4h}^{16}, in which the coordinates of the Cl-atom are x = 0·125; y = 0·167; z = 0·107. In this group the distance of the atoms in the Cl-molecule is 1·99 Å. AUTHORS.

1954. Complex Salts of Dipyridyl with Bivalent and Trivalent Cobalt. F. M. Jaeger and J. A. van Dijk. *K. Akad. Amsterdam, Proc.* 39. 2. *pp.* 164–175, 1936.—The dipyridyl cobaltous salts are prepared by the action of dipyridyl (D) on aqueous solutions of the cobaltous salt in an atmosphere of H_2. More or less similar treatment in air with addition of H_2O_2 gives the corresponding dipyridyl-cobaltic salt. Their crystal forms are :

Salt	System	$a : b : c$	β	Colour
$Co^{II}D_3Cl_2 \cdot 6H_2O$	monoclinic prismatic	0·6018 : 1 : 2·1353	73°12·25′	brown
$Co^{II}D_3SO_4 \cdot 7H_2O$	do.	1·5435 : 1 : 0·9527	81° 8·5′	dark brown
$Co^{II}D_3(H_2O)_2 \cdot SO_4 \cdot 4H_2O$	triclinic prismatic	1·8383 : 1 : 1·1894	α78°24′ β127°45′ γ92°28·5′	yellow
$Co^{II}D_3(NO_3)_2 \cdot 6H_2O$	monoclinic prismatic	1·7568 : 1 : 1·7025	86°20·5′	yellow brown
$Co^{III}D_2(CO_3) \cdot NO_3 \cdot 5H_2O$	do.	0·9033 : 1 : 0·6834	77°22·5′	
$Co^{III}D_3Cl_3 \cdot 3H_2O$	rhombic prismatic	0·858 : 1 : ?		

C. A. S.

1955. Structure of Isomeric Compounds of *d*- and *l*- Acids and Bases. B. Gossner and H. Neff. *Zeits. f. Krist.* 93. 6. *pp.* 488–493, *March*, 1936.—The four isomeric bitartrates of *d*- and *l*-pseudoephedrins are investigated and, in conjunction with earlier experiments on the ephedrin halides, the data have enabled an approximate picture to be constructed of the mutual grouping of the basic and acidic radicals in a species of salt formation. The ephedrin molecule has a chief direction which is very much elongated and about 14 Å in length, whereas in the two directions perpendicular to the greatest elongation and to each other the molecule certainly extends less than 7 Å and probably below 3·5 Å.

H. H. Ho.

1956. Structure of Condensed Ring Compounds. Part III. Carcinogenic Hydrocarbons. J. Iball. *Zeits. f. Krist.* 94. *pp.* 7–21, *April*, 1936. *In English.*—The crystal structure of three carcinogenic hydrocarbons, 1 : 2-benzpyrene, methylcholanthrene, and 5 : 6-cyclopenteno-1 : 2-benzanthracene, have been determined by means of X-rays. It is shown that 1 : 2 benzpyrene exists in two distinct crystalline modifications, monoclinic and orthorhombic. The unit cell dimensions, crystal density and space group are given in each case together with certain optical data. From a consideration of these and of the observed intensity of reflection from various planes some conclusions are drawn as to the molecular arrangement in the respective unit cells. A comparison is made of the structure of 5 : 6-cyclopenteno-1 : 2-benzanthracene with that of the monoclinic form of 1 : 2 : 5 : 6-dibenzanthracene. [For Part II see Abstract 408 (1936).] AUTHOR.

1957. X-Ray Diffraction Intensity of the Two Liquid Phases of Para-Azoxyanisol. G. W. Stewart. *J. Chem. Phys.* 4. *pp.* 231–236, *April*, 1936.—Further experiments with greatly improved conditions show

that the liquid crystal swarms or groups of molecules at 125° C. give an X-ray diffraction intensity distribution curve which is similar to but not exactly like that of the transparent liquid at 150° C. The former has a greater intensity at the peak, and a narrower peak with a steeper slope on the zero angle side. The group in the liquid crystal, about 10^6 molecules, does not have the same structure as the very much smaller and less stable cybotactic group in the liquid. The latter does not need to contain more than 25 to 50 molecules to account for the experimental evidence. The liquid crystal swarms may be descriptively regarded as a regimentation of modified cybotactic groups. A new temperature effect is strongly suggested by the apparent orientation of swarms in the liquid crystal with molecular axes perpendicular to the temperature gradient. [See Abstracts 4335 (1933) and 1810 (1934).] AUTHOR.

1958. X-Ray Diffraction Study of Liquid Sodium. L. P. Tarasov and B. E. Warren. *J. Chem. Phys.* 4. *pp.* 236–238, *April*, 1936. —The X-ray scattering curve for liquid sodium is obtained photographically with Mo*Kα* radiation, monochromatised by reflection from rock-salt. By a Fourier analysis of the corrected scattering curve, the radial distribution of atoms about any atom in the liquid is directly obtained. The distribution curve shows a first concentration at about 4·0 Å, followed by a dip at 5·0 Å, and a second concentration at about 7 Å. The significance of the curve as giving a picture of a simple monatomic liquid is discussed. AUTHORS.

1959. Action of the Electric Field on Anisotropic Liquids. V. Freedericksz and V. Zwetkoff. *Acta Physicochimica*, 3. 6. *pp.* 879–912, 1936. *In German.*—The motion of the liquid in the electric field is first considered. The conclusion is reached that the motion of the layer of liquid orientated by glass surfaces only commences at a definite tension of field which depends on the thickness of the layer. It is observed that to each field strength E a " critical thickness " corresponds which forms a sharp boundary between the moving portions and those at rest. The measurement of the " critical " thickness according to the corresponding strength of field shows that between these magnitudes the relation $Z_0E =$ constant exists. The orientation of the liquid in the electric field is then investigated by the simultaneous action of the electric and magnetic field on a preparation whose thickness does not suffice for the setting-in of motion. Thus it is found that two of the four liquids investigated (*p*-azoxyanisol and *p*-acetoxybenzalazin) follow Zocher's rule. The two other liquids on the contrary are examples of the case where the symmetric molecules (dibenzalbenzidin) orientate themselves parallel to the lines of force, the asymmetric (anisilidenbenzidin) non-perpendicularly. It is shown that the orientation effect is in direct proportion to the square of the field strength and in consequence is conditioned by the dielectric anisotropy of the liquid. It is experimentally proved that the action of the magnetic field can be balanced by an equivalent electric field. The use of h.f. fields ($n > 3 \times 10^5$) shows no difference from l.f. fields. The method gains precision by use of field strengths of higher frequency, whereby the diamagnetic anisotropy of *p*-azoxyanisol in dependence of the temperature can be calculated. The results agree with the experimental data of Foex and Rover. [See also Abstract 979 (1936.] J. J. S.

1960. Production of Large Single Crystals of Lithium Fluoride. D. C. Stockbarger. *Rev. Sci. Instruments*, 7. *pp.* 133–136, *March*, 1936. —Various refinements in the technique of preparing these crystals are

described. In particular stress is laid on the necessity for extreme purity of materials and slowness of growth. Crystals of excellent optical quality up to 3 in. across were obtained grown at the rate of 1 mm. per hr. C. A. S.

1961. Modifications of Uric Acid Crystals by Addition of Dyes to Mother-Liquor. P. Gaubert. *Comptes Rendus*, 202. *pp.* 1192–1194, *March* 30, 1936.—The modifications produced by small additions (1-2/10000) of fuchsine, neutral red, methylene blue, safranine and Bismarck brown are described. Those caused by the four last named are similar *inter se* and differ from those due to fuchsine. Neutral red also affects the cleavage. In all cases solid solutions are formed, and the coloured crystals fluoresce in ultra-violet light. C. A. S.

1962. Effect of β-Naphthalenesulphonic Acid on Crystallisation of $CuSO_4$, $5H_2O$. F. Barillet. *Comptes Rendus*, 202. *pp.* 1194–1195, *March* 30, 1936.—The influence on the crystal form of $CuSO_4 \cdot 5H_2O$ of additions of 0·5, 0·6, 0·8, 1·25 and 5g./l. of β-naphthalenesulphonic acid to a hot solution containing 1250g./l. $CuSO_4 \cdot 5H_2O$ and 10g./l. H_2SO_4, slowly cooled, is described. With 5g./l. of the acid the $CuSO_4 \cdot 5H_2O$ forms innumerable platelets, about 0·01 mm. thick, so numerous that the liquid becomes semi-solid. On kneading a little mother-liquor exudes, the residual mass behaving as a thixotropic liquid. C. A. S.

1963. Crystallisation of Thin Layers of Supercooled Liquids. F. K. Gorsky. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 89–93, 1936. *In German.*—A formula is derived for the maximum number N_{max} of centres of crystallisation for the case in which growth is restricted to two dimensions. If c is the probability and w the linear velocity of crystallisation, then $N_{max} = 0{\cdot}710 \sqrt[3]{(c/w)^2}$. Experiments are carried out with piperine and *o*-nitrophenol in layers of different small thicknesses. In the case of piperine, for which w is small, it is possible to determine probability curves; but in the case of *o*-nitrophenol, for which w is large, only N_{max} in the fully crystallised state is observed. The curve of N_{max} against temperature shows two maxima. Calculation shows that both correspond to the same probability. In the case of *o*-nitrophenol application of an electric field is observed to cause a displacement of the curve towards lower temperature. The form of the probability curve can be accounted for in terms of surface energy and association and the effect of the electric field is explicable as due to alteration of the constants depending upon surface energy. L. A. W.

1964. Young's Modulus of a Crystal in any Direction. I. Koga. *I.R.E., Proc.* 24. *pp.* 532–533, *March*, 1936.—A general expression is obtained for Young's modulus of a crystal in any direction.

1965. Elimination of Error in Debye-Scherrer Photographs. A. Ievinš and M. Straumanis. *Zeits. f. Krist.* 94. *pp.* 40–52, *April*, 1936.—A new method is described for the insertion of the film into the camera. The ends of the film make an angle of approximately 90° with the primary beam. A minimum of calculation is needed for all the necessary corrections. F. I. G. R.

1966. Determinative Crystallographic Tables. A. K. Boldyrew and W. W. Doliwo-Dobrowolsky. *Zeits. f. Krist.* 93. 5. *pp.* 321–367, *March*, 1936.

See also Abstracts 1907, 1934, 2011, 2187, 2248, 2256, 2258, 2259, 2260, 2274, 2283, 2339, 2353, 2354, 2377, 2378, 2392, 2395.

DENSITY.

1967. Liquid Densities of Propylene and Methyl Ether by a Modified Dilatometer Method. D. B. Pall and O. Maass. *Canad. J. of Research*, 14. *Sect. B. pp.* 96–104, *March*, 1936.—A modification of the dilatometer method for measuring the density of liquids which can be applied over a large temperature range and up to the region of the critical temperature is described. The densities of methyl ether and propylene are measured over the temperature range 7°–120° C. and 20°–88° C. respectively, with an accuracy of 1 part in 2000. A comparison is made with the data of other investigators. Application of the data to the law of corresponding states shows that the law holds to within the accuracy attained up to temperatures at least 0·96 of the critical. AUTHORS.

1968. Volume Change of Heavy Water at the Freezing Point. J. Timmermans, M. Hennaut-Roland and D. Rozental. *Comptes Rendus*, 202. *pp.* 1061–1063, *March* 23, 1936.—The variation of the fusion temperature with pressure (dT/dp) is calculated from the Clapeyron-Clausius formula, and the data compared with that furnished by direct experiment and with the constants of H_2O. Experimental details are included, and the following results obtained :—

D_2O : $d_{0°} = 1·01471$; specific volume $= 0·9855$.

H_2O : $d_{-5°} = 0·9159$; specific volume $= 1·0920$.

The difference between the specific volumes of D_2O in the solid and liquid states is 0·0811, a result superior to the former values obtained by indirect methods. Previous work on this subject is discussed. H. H. Ho.

See also Abstracts 1931, 2191, 2276, 2369.

DIFFUSION AND OSMOSIS.

1969. Diffusion and Viscosity Curves of Binary Mixtures. H. Lemonde. *Comptes Rendus*, 202. *pp.* 731–733, *March* 2, 1936.—When D, η, and Dη are plotted against % of EtOH in EtOH-H_2O mixtures it appears that D and (for more than 35 % EtOH) Dη are greater at 18° than at 10°. Dη having the dimensions of a force may be regarded as the motive force of diffusion between the molecules of two infinitely near diffusing layers of very slightly differing concentration and it depends on the difference in the osmotic forces of these layers. Its magnitude is a function of the difference in concentration of these layers, of their thermal agitation, and of intermolecular actions. Increase in Dη indicates a tendency towards association and *vice versa*. The inferences thus deduced for various mixtures agree with those deduced from azeotropism and otherwise. [See Abstract 1451 (1936) and following Abstract.] C. A. S.

1970. Diffusion and Azeotropism in Binary Mixtures. H. Lemonde. *Comptes Rendus*, 202. *pp.* 1069–1071, *March* 23, 1936.—The isotherms of vapour pressure (V), diffusion (D) and diffusing force (Dη) have been compared for 12 binary mixtures from among pairs of $CHCl_3$, $COMe_2$, H_2O, EtOH, PrOH, C_6H_6, C_7H_8, and C_6H_{14}. The result shows that diffusion varies more or less inversely as vapour pressure. Comparision of V and Dη curves classifies the mixtures into three groups according as the Dη curve shows a maximum, a minimum or (the V curve being approximately straight) a close similarity to the viscosity (η) isotherm. These three groups show respectively negative, positive and nil azeotropism. [See preceding Abstract.] C. A. S.

1971. Thermal Diffusion in Deuterium Mixtures. K. E. Grew and B. E. Atkins. *Phys. Soc., Proc.*, 48. *pp.* 415–420, *May* 1, 1936. —With the object of comparing the molecular fields of H_2 and D_2, the thermal diffusion effects in H_2–N_2 and D_2–N_2 mixtures are measured over a temperature-range $-190°$ to $+100°$ C. It appears that D_2 has the same type of field as H_2. He–N_2 mixtures, which are of interest because the mass ratio is the same as in D_2–N_2 mixtures, are also examined.

AUTHORS.

***1972. Membranes as Models of Physiological Objects. R. Höber.** *Naturwiss.* 24. *pp.* 196–202, *March* 27, 1936.—A discussion of the action of botanical and zoological cells by means of a model of a permeable membrane. The author relates the permeability and transmission of salts, etc., through the membrane to the action of the cell-wall surface. He describes at length the ionic permeability of such pore membranes, the alterations in permeability of such membranes and their reproduction by means of his model and finally the fundamental issues concerned with the permeability of surface films. The matter is also referred to the fine structure of the cell wall and the action of enzymes. A purely physical explanation of natural phenomena. S. G. B.

See also Abstract 2303.

ELASTICITY AND PLASTICITY.

1973. Castigliano's Principle of Minimum Strain-Energy. R. V. Southwell. *Roy. Soc., Proc.* 154*A*. *pp.* 4–21, *March* 2, 1936.—There are two important theorems on the elastic equilibrium of a body which obeys Hooke's law. The first theorem states that of all configurations of an elastic body, in which specified displacements are imposed on particular points, that configuration which does not require additional forces to maintain equilibrium gives a minimum value for the elastic strain-energy. The second theorem, here called " Castigliano's Principle of Minimum Strain-Energy," states that for all configurations of a body which satisfy the conditions of equilibrium for a given system of forces, that one which has resulted from an initial state of ease gives a minimum value for the elastic strain-energy. Both theorems are proved from simple energy considerations by using the principle of superposition. The second of the above theorems is then applied first to establish the well-known conditions of compatibility satisfied by the strain components, secondly to give direct solutions of the three problems, Saint-Venant's problems of uniform flexure and torsion and the uniform flexure of a flat circular ring. A. J. McC.

1974. Strength of Braced Cylinders. T. M. Megaw. *Inst. Civ. Eng., J. No.* 5. *pp.* 356–360, *March*, 1936.—A brief account is given of the results of Bryan and Southwell on the elastic stability of thin cylinders. The case of a thin cylindrical shell with stiffening rings braced by a polygonal arrangement of struts is considered with the aid of Southwell's formula. Two types of instability failure are discussed : failure as a long cylinder, the number of lobes in the distorted form being equal to the number of sides in the bracing system : and failure as a short cylinder, the length being that between the bracing planes. The stresses in this structure are analysed by 2 methods, one 2- and the other 3-dimensional, and the conclusions drawn from the analyses are embodied in a number of suggested rules for design. H. J. H. S.

1975. Equilibrium and Elastic Stability of a Thin Twisted Strip. A. E. Green. *Roy. Soc., Proc.* 154*A*. *pp.* 430–455, *April* 1, 1936. —A twist can be produced in a flat rectangular bar or thin strip which is much larger than that allowed for by the first order, or St. Venant, theory ; and consequently, the usual linear relation between the couple and the twist is no longer true. A formula for the couple is found which includes a second-order term depending on the cube of the twist. This term arises from the extension or contraction of linear elements which, in the unstrained state, are parallel to the length of the strip. The formula agrees fairly well with experiments, but, at a well-defined value of the twist, the strip became unstable. A theoretical investigation is made into the elastic stability of a thin twisted strip and it is found that the strip does become unstable at a definite value of the twist, which is slightly greater than that observed. This difference is probably due to lack of straightness in the strip. For steel the instability occurs when the couple reaches 1·43 times the St. Venant couple. This result is independent of the ratio thickness/width. Two different strips of steel have been used in the experiments. The results are represented on separate graphs for each strip, and also in a non-dimensional form on one graph. AUTHOR.

1976. Flexure of a Prism with Cross-Section Bounded by a Cardioid. W. M. Shepherd. *Roy. Soc., Proc.* 154*A*. *pp.* 500–509, *April* 1, 1936.—Rectangular axes are taken such that the generators of the cylindrical surface of the prism are parallel to Oz which passes through the centroids of the cross-sections. The load is applied at one end. Equations are given for the displacements and stresses. Two cases are taken : (1) when the plane of symmetry is the same as the plane of flexure, and (2) when those planes are at right angles. The equations for the shear are deduced and values calculated for about 50 points to get the lines of pressure shear in the section. These lines are shown in a diagram for each case. The results are compared with those found for other sections and a correction given for the results obtained in an earlier paper. [See Abstract 864 (1933)]. R. S. R.

1977. Theorem of Singularity for Limiting Problems in the Theory of Elasticity. A. S. Bakaliajev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 2. *pp.* 55–58, 1936. *In French.*—A closed surface is considered and the limits for the exterior region of this surface are dealt with. The wave equations for the theory of elasticity are stated and the singularity of the solution proved. R. S. R.

1978. Stresses in a Notched Plate under Tension. F. G. Maunsell. *Phil. Mag.* 21. *pp.* 765–773, *April*, 1936.—The stresses in a semi-infinite plate, notched by a single semi-circular notch, and under a tension T, are determined. It is found that the maximum concentration of stress is very nearly 3T and most probably the correct value is 3T. This differs from the value 2T obtained by Leon by an admittedly imperfect method and is considerably greater than the value 2·5T deduced by Coker and Filon from Capper's experiments. The distribution of stresses shows a general likeness to that around a circular hole in an infinite plate under tension, the principal difference being in the value of $\overline{\theta\theta}$ near the corners of the notch. R. S. R.

1979. Effect of Pressure on Volume and Resistivity of Intermetallic Compounds. P. W. Bridgman. *Am. Acad., Proc.* 70. 7. *pp.* 285–317, *Dec.*, 1935.—Attention is drawn to systematic errors in the author's previously published data, one series being experimental, the

other arithmetical. Data published since 1925 are further vitiated by being based on an erroneous value for the compressibility of iron, which has been used as fundamental in all determinations. Formulæ, usually without numerical experimental data, are given for 17 intermetallic compounds in the cubic system, $MgZn_2$ (hexagonal), Ge, LiF, Ag_2S, PbSe, PbTe, $Ag_2SO_4 \cdot 4NH_3$ (tetragonal), synthetic basalt, mostly measured at 30° C. and 75° C. and in some cases both in the annealed and unannealed states. Pressure hysteresis, creep, discontinuities and changes in direction of the curves occur frequently. Observed compressibilities of intermetallic compounds vary from 51 % to 116 % of the values calculated by rule of mixtures, being usually less. This is consistent with high internal pressure consequent on chemical affinity. Resistivity is almost always higher than the value calculated by the mixture rule. D. R. H.

1980. Estimation of Elastic Compression Limits in Conjunction with Hardness Determinations. G. Tammann and W. Müller. *Zeits. f. Metallkunde*, 28. *pp.* 49–54, *March*, 1936.—The shape of the impression made by a loaded steel cone or sphere in a metal is described ; it is shown to depend on the grain size (and on the orientation in the case of a single crystal) and the elastic limits of the metal. It is shown how the hardness number, determined by means of a loaded cone, may be related in a simple manner with the elastic limits. In illustration, the variation of these two factors with the degree of rolling is determined. H. J. H. S.

1981. Variations of Rigidity Modulus with Changes in Applied Stress. Gladys M. Francis. *Physics*, 7. *pp.* 160–162, *April*, 1936.—An attempt to determine by an interferometer method whether or not any variations occurred in the rigidity modulus similar to those which occurred in Young's modulus in D. K. Froman's experiment [*Phys. Rev.* 35. *p.* 264. *Feb.* 1930]. Any variations of more than 0·1 of a fringe could readily be detected. No such variations occurred. Author.

1982. Rheological Properties of Asphalts. Part III. Viscosity Index. R. N. Traxler and H. E. Schweyer. *Physics*, 7. *pp.* 67–72, *Feb.*, 1936.—A review is given of previous work on the temperature-viscosity relations of bituminous materials. Viscosity measurements at 15° to 35° are made on 14 asphalts of paving consistency by means of the alternating stress method of Bingham and Stephens. An asphalt-viscosity index is established defined by A.V.I. $= 100(10^a - 1)$ where "a" is the slope of the log-viscosity versus temperature plot. To evaluate A.V.I. it is only necessary to determine experimentally the viscosity at two temperatures (where the straight line relation holds) and substitute in the expression A.V.I. $= 100[(\eta_c/\eta_d)^{1/(t_c - t_d)} - 1]$. [For Part II see Abstract 1391 (1935).] J. K.

1983. Recent Research in Elasticity. J. N. Goodier. *J. of Applied Mechanics*, 3. *pp. A26–A27, March*, 1936.—A short review.

1984. Properties of Characteristic Oscillations. F. H. van den Dungen. *Comptes Rendus*, 202. *pp.* 625–627, *Feb.* 24, 1936.—Some properties of vibrations characteristic of linear systems, without gyroscopic terms are investigated. Earlier properties are completed and extended—and may be used in the theoretical study of pulsation as well as in practical determinations. An equation between the internal potential, the kinetic energy and the dissipated energy of a system is given, and the vibrations arising from various deformations are discussed. [See also Abstract 1481 (1936).] H. M. B.

1985. Propagation and Resonance of Longitudinal Waves in Prismatic Rods. R. Ruedy. *Canad. J. of Research*, 14. *Sect. A. pp.* 48–55, *Feb.*, 1936.—For vibrations involving shearing and rotation, and for those involving both distortion and dilatation, the equations of motion combined with the boundary conditions yield in the simplest case a cubic equation for the resonance frequencies ; its solution depends on Poisson's ratio and on the resonance frequencies f_x, f_y, f_z, which the rod possesses when in pure shearing motion in the direction of its three axes. Three series of resonance frequencies are obtained when f_y and f_z are constant and the frequencies of the overtones are inserted for f_x. A fourth series of resonance frequencies begins above the highest of the fundamental frequencies f_x, f_y, f_z. [See following Abstract.] AUTHOR.

1986. Propagation and Resonance of Composite Waves in Prismatic Rods. R. Ruedy. *Canad. J. of Research*, 14. *Sect. A. pp.* 66–70, *March*, 1936.—By taking into account the three main terms of the equation of motion of the prismatic rod, there is obtained for the frequency a cubic equation which is in good agreement with the experimental results when the thickness of the rod is not negligible compared with its length but does not exceed about one-fifth of the length. It corresponds to the equation obtained for a system with three degrees of freedom. For a composite vibration consisting of a wave of dilatation and a wave of distortion in the direction of the smallest dimension of the rod, and waves of dilatation in the two other directions, the equations of motion combined with some of the boundary conditions yield another cubic equation for the resonance frequencies. [See preceding Abstract.] AUTHOR.

1987. Transverse Vibration of a Square Plate Clamped at Four Edges. S. Tomotika. *Phil. Mag.* 21. *pp.* 745–760, *April*, 1936.—The transverse vibration of a square plate of uniform small thickness clamped at its four edges is discussed, for normal modes of vibration in which displacements are symmetrical with respect to the axes ξ and η taken parallel to the edges of the square. By finding the forms of displacement which satisfy both the clamped-edge condition and the differential equation for the transverse vibration of the plate a formal solution of the problem is obtained, and the frequencies of the normal modes of vibration are expressed as values which cause an infinite determinant to vanish. The frequency p of vibration in the fundamental mode is given by $\rho ha^4p^2/D\pi^4 = 13{\cdot}2948$, where a, h are the length of the side and the thickness of the plate respectively, ρ the density of the material of the plate, and D is the flexual rigidity, expressed in terms of h, E, σ by $D = \frac{1}{12} Eh^3 (1 - \sigma^2)^{-1}$, E and σ being Young's modulus and Poisson's ratio respectively of the material of the plate. [See also Abstract 1011 (1936).] AUTHOR.

***1988. Simplified Apparatus for High Hydrostatic Pressures. L. H. Adams.** *Rev. Sci. Instruments*, 7. *pp.* 174–177, *April*, 1936.—A simple type of high pressure apparatus is described. Pressure is generated in a hardened steel cylinder, or bomb, which has a piston actuated by a hydraulic press. The piston packing consists of a rubber stopper and a layer of oil, which floats on the pressure-fluid (water or any liquid or solution immiscible with oil). A pressure of 10,000 atmospheres is readily obtained, and is measured by means of a glass piezometer. The apparatus is inexpensive, easy to operate, and suitable for precise measurements of many kinds. AUTHOR.

See also Abstracts 2000, 2092, 2113, 2114, 2115, 2188, 2284, 2303.

GRAVITATION.

1989. Gravitational Anomalies: Effect of Density Errors. A. Mercier. *Arch. des Sciences,* 18. *pp.* 21–23, *Jan.–Feb.,* 1936.—The author regards the continents as blocks of sial in hydrostatic equilibrium in sima. Any error in the assumed densities will affect the mean level of contact of sial and sima and the calculated gravity anomaly. It is shown that the difference of the two densities is of prime importance for the value of the anomaly; while the possible range of error is affected rather by the assumed density of the sial. The necessary formulæ are given.

T. L. M.

1990. Tables for Determining the Form of the Geoid and its Indirect Effect on Gravity. W. D. Lambert and F. W. Darling. *Coast and Geodetic Survey, Special Publ. No.* 199. [125 *pp.*], 1936. —The tables given include the values for the deformation of the geoid and its effect on gravity, calculated from several formulæ, including those of Lambert and Cassini; density of compensation for computing special Bowie tables, including depth of compensation at 96 km. and 113·7 km. for both continental and oceanic areas; Bowie reduction tables; tables for determining the geoid from gravity anomalies; and data for use in computing the potential of the Hayford zones. W. A. R.

***1991. Demonstration Experiment for Falling Movement. J. Kömmnick.** *Zeits. f. techn. Physik,* 17. 3. *pp.* 101–102, 1936.—A demonstration experiment is described to find the acceleration due to gravity (g). A falling rectangular piece of paper is penetrated by a.c. sparks. The registering strip can be projected and from the known interval of the sparks and the distance apart of the marks g can be determined. The numerical procedure is given and the deviations of many individual values do not differ from the mean by more than 1 %. R. S. R.

HYDRODYNAMICS AND AERODYNAMICS.

1992. Velocity and Temperature Distributions for Flow along a Flat Plate. L. Howarth. *Roy. Soc., Proc.,* 154*A*. *pp.* 364–377, *April* 1, 1936.—The theoretical results obtained by Kármán and Prandtl for turbulent flow near a plane boundary are considered. Kármán's logarithmic formula for the velocity distribution is regarded as empirical. An attempt is made to obtain this velocity distribution on a theoretical basis, but mathematical difficulties prevent an entirely satisfactory solution being obtained. It is found necessary to include an empirical factor to express the variation of mixing length with distance from the leading edge. On the momentum theory the temperature distribution in the boundary layer over a heated plate is identical with the velocity distribution. On the vorticity theory the two distributions are no longer identical, but it is shown that they may be in as close agreement as the somewhat scattered experimental points.

R. W. P.

1993. Slow Motion of Fluid. W. R. Dean. *Phil. Mag.* 21. *pp.* 727–744, *April,* 1936.—The author investigates mathematically some cases of the slow motion of fluid bounded by two semi-infinite coplanar boundaries having their straight edges parallel and at a finite distance apart, due to a jet of fluid of finite width, the jet entering the region with a constant uniform velocity in a direction either perpendicular to the boundaries or inclined thereto. J. S. G. T.

1994. Permanence of Alternate Vortices in a Rectilinear Channel. P. Schwarz. *Comptes Rendus*, 202. *pp.* 824–826, *March* 9, 1936.—The author has previously examined the oscillatory motion of a Bénard-Kármán vortex street in a straight channel [see Abstract 1464 (1936)]. Rosenhead has shown that such a street is stable only when the median line of the vortices coincides with the axis of the channel [see Abstract 867 (1930)]. The author now deduces the condition to be satisfied by a vortex street asymmetrically arranged with respect to the axis of the channel, and the criterion for the non-existence of a stable system. J. S. G. T.

1995. Bénard-Kármán Vortices behind an Obstacle, in Motion in a Rectilinear Channel. P. Schwarz. *Comptes Rendus*, 202. *pp.* 1021–1024, *March* 23, 1936.—It is shown mathematically that the width of a Bénard-Kármán vortex street in a rectilinear conduit must necessarily increase or decrease. J. S. G. T.

1996. High-Velocity Air Flow in Smooth, Straight Pipes. W. Frössel. *Forsch. IngWes.* 7. *pp.* 75–84, *March–April*, 1936.—A dependence between the mass flowing through, the distribution of pressure along the tube, and the tube length is proved. The coefficient of friction and the velocity distribution over the cross-section are determined. W. A. R.

1997. Measurement of Air Flow and Method of Rendering the Flow Visible. U. Schmieschek. *Zeits. f. techn. Physik*, 17. 3. *pp.* 98–100, 1936.—Macroscopic particles of "Meta" (a commercial variety of polymerised acetaldehyde), vaporised in the stream by heating with a soldering iron and then condensing, are photographed. J. S. G. T.

1998. Theory of Gaseous Jets. D. Riabouchinsky. *Comptes Rendus*, 202. *pp.* 889–891, *March* 16, 1936.—By making a number of simplifying assumptions a mathematical analysis is obtained which gives the pressure and velocity distribution in a gaseous jet. An undulatory movement of the gas is indicated. R. W. P.

See also Abstract 2281.

KINETIC THEORY OF MATTER.

1999. Kinetic Theory Applied to Evaporation and Sublimation of Monatomic Gases. P. D. Crout. *J. Math. Phys.* 15. *pp.* 1–54, *Feb.*, 1936.—From primary considerations it is shown that the vapour cannot be isotropic in the immediate neighbourhood of a liquid surface from which evaporation occurs. A single temperature cannot therefore be assigned to the gas. In the present mathematical analysis of the problem two temperatures are assigned to the gas, a "longitudinal temperature" in the direction of evaporation, and a "transverse temperature" at right angles to this direction. One result is to show that the rate of evaporation cannot exceed that rate which corresponds to a drift velocity of the isotropic gas equal to the velocity of sound in the gas. Tables and curves are prepared which are applied to solve a variety of problems involving the evaporation of Hg. The Hg evaporates through a short cylindrical tube into a vacuum or an enclosure at a specified pressure; the quantities dealt with are the liquid surface temperature and pressure, the rate of evaporation and the state of the gas in the tube. R. W. P.

2000. General Physics (Classical): Brownian Motion, Surface Tension, Rayleigh's Principle, Viscosity. A. Ferguson. *Phys. Soc., Reports*, 2. *pp.* 1–26, 1935.

See also Abstract 1971.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***2001. Photoelectric Extensometer for Very Small Gauge Lengths. E. Lehr and H. Granacher.** *Forsch. IngWes.* 7. *pp.* 66–74, *March–April,* 1936.—A new type of extensometer 40 mm. long and weighing about 15 gm. is described with the aid of sectional views. The gauge points are 2 mm. apart and the extension is magnified mechanically about 50 times by levers which cause a slit to vary its width. A ray of light from a lamp within the extensometer passing through the slit falls on a small plane photoelectric cell at the end of the instrument, and the current produced is magnified until a total extensometer magnification of over 30,000 times is obtained. Methods of calibrating the instrument and attaching it to a specimen are described together with an automatic hand punch for marking off the specimen. The accuracy of the instrument is compared with a Huggenberger extensometer by a series of tests upon a flat disc spring, and the experimental results are given in graphical form together with calculated values. R. H. G.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

2002. Numerical Solution of Differential Equations. V. M. Falkner. *Phil. Mag.* 21. *pp.* 624–640, *March,* 1936.—An account of a modification of Adams' step-by-step method of integration. The method is based on the use of the difference table of the highest order derivative occurring in the equation to be integrated, and two equations, of which the second is non-linear, are solved in illustration of the method. G. E. A.

2003. Harmonic Analysis by Means of Linear Combinations of Ordinates. H. Labrouste and (Mrs.) Labrouste. *Terr. Mag.* 41. *pp.* 15–28, *March,* 1936.—This memoir on the method of analysis by means of linear combinations of ordinates comprises three chapters. The first is devoted to the statement of the principle of the method and the examination of the properties of the simple combinations by which are formed the multiple and resultant combinations which are dealt with in the second chapter. In the latter, the curves of selectivity of the different combinations are also discussed. The last chapter deals with the practical method of analysis based on the theoretical considerations developed in the first two chapters. A numerical example is given, which illustrates the method. The case of damped sine-waves is considered both from the theoretical and the practical point of view. AUTHORS.

2004. Units of Weight and Measure (United States Customary and Metric). Definitions and Tables of Equivalents. *Bureau of Standards, Misc. Publ. M.* 121. [68 *pp.*], 1936.

See also Abstracts 1921, 2007, 2010, 2344.

MECHANICS, CLASSICAL.

2005. Application of Elliptic Functions to the Plane Motion of a Particle under the Action of a Central Force. H. Tallqvist. *Soc. Scien. Fennica, Comm. Phys.-Math.* 8. 24. [58 *pp.*], 1936.—Discusses the general motion of a particle, which is constrained to move in a plane and is acted upon by a force directed towards a centre not in the plane. The following laws of force are treated in detail: (1) constant force, (2) the

inverse square law, (3) the inverse cube law, (4) partly the direct distance and partly the inverse cube; and the complete integrals of motion are expressed in terms of the Weierstrassian elliptic functions. A. J. McC.

2006. Anepicyclic Regions in the Restricted Problem of Three Bodies. N. Moissejev. *Comptes Rendus (Doklady) de l'Acad des Sciences, U.S.S.R.* 1. 2. *pp.* 63–66, 1936. *In German.*—It is shown how to find regions in which an ordinary trajectory, with no singularity in the the sense of Hadamard, cannot be enclosed. G. C. McV.

2007. Small Movements of a System Subject to Gyroscopic Forces. F. H. van den Dungen. *Comptes Rendus*, 202. *pp.* 1014–1015. *March* 23, 1936.—These movements are derived from properties following from the principle of smallest demand. It is shown what form it is advisable to give to this principle in order to recognise similar properties. Forced and free motions are considered and the system can be extended to the case of any kind of dissymmetric coefficients. R. S. R.

***2008. Precession and Nutation of Gyroscopes. R. C. Colwell and N. I. Hall.** *Rev. Sci. Instruments*, 7. *pp.* 153–154, *March*, 1936.—When a symmetrical top is precessing at a constant angle to the vertical the rate of precession is given by two equations and these are called the fast and slow precessions. In the ordinary gyroscope running at speeds below 10,000 r.p.m. the fast precession is negligible compared to the slow and it is mostly neglected. If a top is spinning above 30,000 r.p.m. the fast precession assumes considerable importance. Examples are given and discussed of balanced tops which can be used to illustrate the fast precession and combinations of precession and nutation. R. S. R.

***2009. Gyroscopes and Tops with Ball Bearings. R. C. Colwell and N. I. Hall.** *Science*, 83. *p.* 289, *March* 29, 1936.—In the usual form of gyroscope, the spinning member is attached to one end of a rod and a counter weight to the other. The rod is supported at its centre by a stand in such a way that it can rotate about one horizontal axis and the vertical axis. The gyroscope is thus free to move up and down in nutation and also to rotate about the vertical axis in precession. If however the rod is placed in a bearing at the point of support it can also rotate about its own axis. This gives another degree of freedom to the top and if the counter weight is placed on a second rod at right angles to the main rod it is possible to give two couples to the gyroscope. Details of such an apparatus are given. In this way the different types of precession and nutation can be shown as desired. R. S. R.

***2010. Accuracy of Transmission Dynamometers, Integrators of Energy. G. Bourdelle.** *Comptes Rendus*, 202. *pp.* 1152–1153, *March* 30, 1936.—The conclusions are reported of an investigation of transmission dynamometers of the type in which the transmitted energy is integrated by means of an arrangement multiplying the couple by the instantaneous angular displacement. It was found that, on account of slight unwedging, an error is produced which is relatively greater the smaller the couple. When the couple is variable the resultant total error is not simply expressible. The smallest error found was 1·29 % and an error of 2 to 3 % may generally be expected. To obtain greater precision the couple and angular displacement must be measured separately. P. H. B.

See also Abstracts 1984, 2022, 2023, 2067.

MECHANICS, QUANTUM.

2011. Quantum Theory: Edited by G. Temple. Part I. Quantum Theory of Atomic Nuclei. R. Peierls. Part II. Spectra of Polyatomic Molecules. G. B. B. M. Sutherland. Part III. Quantum Theory of Valency. W. G. Penney. Part IV. Theory of Paramagnetism and Related Properties in Ionic Crystals. R. Schlapp and W. G. Penney. *Phys. Soc. Reports*, 2. *pp.* 27–73, 1935.

2012. Reality in Quantum Mechanics. R. Dugas. *Comptes Rendus*, 202. *pp.* 636–638, *Feb.* 24, 1936.—Einstein recently formulated, as a sufficient condition for the reality of a physical quantity, the possibility of predicting it with certainty without disturbing the system [see Abstract 2411 (1935)]. A critical examination of this leads to the conclusion that the above criterion, though valid in classical mechanics, can be reconciled with quantum mechanics only when the latter is restricted to a consideration of ideal cases in which the measurements involve no perturbation. N. M. B.

2013. Physics and Reality. A. Einstein. *Frank. Inst., J.* 221. *pp.* 313–347 (*In English*) *and pp.* 349–382 (*In German*), *March*, 1936.—The philosophical basis of physical theory is considered starting from the general premise that the aim of such theory is to make the world of sense impressions comprehensible. The foundations of the theory consist of propositions which are not derived inductively from observation but are merely axiomatic starting points of a logical structure connecting sense impressions. Newtonian mechanics and the theory of relativity are analysed and serve to illustrate the point that the more comprehensive a theory is, the more its logical foundations are remote from direct experience. The quantum theory, it is maintained, cannot provide a new and more comprehensive basis for physics. For the author assumes that there is such a thing as a real physical condition of a single system and also that any satisfactory theory must enable us to describe completely this condition of the system. But quantum theory, with its concept of the probability of a system being in a certain state, denies that a complete knowledge of the condition of a system can be known. A new basis of physics is to be sought in the concept of the field and the singularity-free solutions of the differential equations describing it. It is remarked that the Schwarzschild solution in general relativity can be represented as singularity-free by a suitable choice of coordinates. G. C. McV.

2014. Theory of the Hydrogen Atom. V. Bargmann. *Zeits. f. Physik*, 99. 7–8. *pp.* 578–582, 1936.—It is shown that the matrix equations forming the basis of Pauli's theory of the H atom, lead, by treatment along group-theory lines, to the result obtained by Fock [see Abstract 471 (1936)]. The separation of the Schrödinger equation in terms of parabolic coordinates is derived. J. S. G. T.

2015. Interaction of Two Particles. H. R. Hulme. *Roy. Soc., Proc.* 154*A*. *pp.* 487–500, *April* 1, 1936.—The interaction of two particles is considered according to the methods of quantum electrodynamics and to fix ideas the interaction of a particle in the nucleus of an atom with an electron in the K-shell is considered. In this form the work is applicable to the theory of internal conversion. The nuclear particle is taken to be initially in an excited state, and in order to obtain an unambiguous result it is necessary to take into account its finite life-time in this state. A result is obtained which agrees with that found by Møller using correspondence methods. In terms of the latter theory the present results show that

for bound particles it is essential to take the *retarded* potentials due to the transition where the first particle jumps down, and then consider these as perturbing the second particle. On the other hand, for free particles it is immaterial whether retarded or advanced potentials be taken, and by taking the mean the result may be put in the symmetrical form expected for free particles. AUTHOR.

2016. Self-Consistent Field, with Exchange, for Beryllium. Part II. D. R. Hartree and W. Hartree. *Roy. Soc., Proc.* 154*A*. *pp.* 588–607, *May* 1, 1936.—Fock's equations for the self-consistent field, including exchange terms, are obtained and solved numerically for the $(2s)$ $(2p)$ ^3P and ^1P terms of neutral Be. The radial wave functions are not the same for the two terms arising from this configuration, and in deriving Fock's equations it is necessary to justify the use, for this case, of Slater's method for obtaining the expression for the energy in terms of the radial wave functions. A general method of deriving Fock's equations by formal differentiation of this expression is given. The numerical work for the two terms had to be carried out separately, and for the ^1P term was rather troublesome on account of the sensitiveness of the $(2p)$ wave functions. The $(2s)$ wave function is considerably different for the two terms, and the difference is still greater for the $(2p)$ wave function. Energy values are calculated and found to be in satisfactory agreement with observation ; in particular the singlet-triplet separation agrees much better with the observed value than does the separation calculated from the self-consistent field without exchange, in which the difference between the radial wave functions for the two terms is neglected. [For Part I see Abstract 2406 (1935).] AUTHOR.

2017. Development of the Quantum Equation and a Possible Limit to its Application. H. T. Flint. *Phys. Soc., Proc.* 48. *pp.* 433–443, May 1, 1936.—The first-order equation of the quantum theory is developed by applying a parallel displacement to the matrix length of a vector. The quantum theory reveals itself as a law of parallel displacement from which a modification of Weyl's theory is deduced. In this modification a term containing the mass of a charged particle occurs as well as terms containing the charge and electromagnetic potential.. The principle of minimum proper time emerges from this result as a limitation of the application of the quantum equation to a particle in an electromagnetic field. AUTHOR.

2018. Combined Approximation Method for Energy Calculations in Many-Electron Problems. H. Hellmann. *Acta Physicochimica*, 4. 2. *pp.* 225–244, 1936. *In German.*—The author modifies his method for the calculation of the energy in many-electron problems by altering the Fermi statistical formulæ so as to include the case when the valency electrons have arbitrary angular momentum quantum number.

G. C. McV.

2019. Quantum Variations. R. v. Hirsch. *Ann. d. Physik*, 25. 8. *pp.* 697–704, *April*, 1936.—The author discusses a formula for the mean-square departure from the normal of the energy of a collection of molecules. G. C. McV.

See also Abstracts 1920, 2332, 2371, 2373, 2398.

RELATIVITY AND ETHER.

2020. Lorentz Formulæ and the Principle of Relativity. E. Esclangon. *Comptes Rendus*, 202. *pp.* 708–712, *March* 2, 1936.—The author shows that the Lorentz formulæ are derivable from the existence

of three systems in uniform relative motion between which reciprocity exists. This means that for each system the phenomena of nature appear and develop in an identical manner. In establishing the Lorentz formulæ it is therefore not necessary to make an *a priori* appeal to the constancy of the velocity of light. [See following Abstract.] G. C. McV.

2021. Lorentz Formulæ. E. le Roy. *Comptes Rendus*, 202. *pp.* 794–795, *March* 9, 1936.—Referring to the demonstration by E. Esclangon [see preceding Abstract] the author points out that he has already given a proof of this theorem which he now repeats. G. C. McV.

2022. Abnormal Solution of a Mechanical Problem Deduced from the Principle of Relativity. E. Esclangon. *Comptes Rendus*, 202. *pp.* 885–889, *March* 16, 1936.—The author constructs a type of accelerated motion whose equations are invariant under Lorentz transformations and which gives dissymmetry in two perpendicular directions. [See following Abstract.] G. C. McV.

2023. Application of the Principle of Relativity to a Dynamical Problem. E. Esclangon. *Comptes Rendus*, 202. *pp.* 993–995, *March* 23, 1936.—The conditions in special relativity are studied, under which a particle can move with constant acceleration and in directions which are invariable, but not necessarily identical, in each of two inertial systems. The condition found is that the velocity component normal to the direction of the force producing the acceleration is constant. [See preceding Abstract.] G. C. McV.

2024. Fields of Uniform Acceleration in Special Relativity. E. Cartan. *Comptes Rendus*, 202. *pp.* 1125–1128, *March* 30, 1936.—The problem of the equations of motion of a particle moving under a constant acceleration, and which are invariant under Lorentz transformations, is considered. It is shown that a field of uniform acceleration is characterised by its intensity and the direction and sense of the limiting velocity which every moving particle in the field tends to acquire. G. C. McV.

2025. New Relativity. Part II. Transformation of the Electromagnetic Field Between Accelerated Systems and the Force Equation. L. Page and N. I. Adams, Jr. *Phys. Rev.* 49. *pp.* 466–469, *March* 15, 1936.—The transformation for **E** and **H** between equivalent Euclidean reference systems with constant relative acceleration is obtained, and the necessary modification of the classical equation of motion of the electron is deduced. [For Part I see Abstract 1057 (1936).] AUTHORS.

2026. Fundamental Equations of General Relativity Theory. J. Ghosh. *Zeits. f. Physik*, 99. 7–8. *pp.* 583–584, 1936.—It is pointed out that the Einstein equations involving the cosmical constant can be put in the form $G_{\rho\sigma} - \frac{1}{4} g_{\rho\sigma} G = -8\pi (T_{\rho\sigma} - \frac{1}{4} g_{\rho\sigma} T)$. G. C. McV.

2027. Gauss's Theorem in General Relativity. G. Temple. *Roy. Soc., Proc.* 154*A*. *pp.* 354–363, *April* 1, 1936.—A complete solution is given of the problem of constructing the widest extension of Gauss's theorem on the Newtonian potential which is valid in general relativity. The theorem is expressed in the form —" source integral " equals " flux integral "—where the flux integral involves the potentials, $g_{\mu\nu}$ and their first derivatives, and is taken over a closed 2-way, S_2; and the source integral involves the stress tensor, $T_{\mu\nu}$, and is taken over any 3-way S_3, bounded by the prescribed S_2. The gravitational tensors are expanded as power series in the constant gravitation γ, and attention is concentrated on the leading terms. This device reveals a system of teleparallelism which is

intrinsic in the Riemannian geometry of the gravitational field and enables Gauss's theorem to be constructed in an explicit form. [See Abstract 1996 (1935).] AUTHOR.

2028. Simple Example of Born's Electrodynamics. S. Šubin and A. Smirnow. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 2. *pp.* 69–72, 1936. *In German.*—The properties are investigated of a plane, monochromatic light-wave in space characterised by a homogeneous electrostatic field which is weak compared with the critical field. It is shown that the field vectors, E and B of the light wave behave, to a first approximation, just as they would in a uniaxial crystal of principal dielectric constant, ϵ, given by $\epsilon = 1 + N^2/b^2$, N denoting the field strength, and b the critical field. Other results are briefly interpreted in terms of Dirac's positron theory. J. S. G. T.

2029. Unitary Theory of Field and Matter. Part II. M. Born. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 85–97, *Feb.*, 1936.—Kramers' " classical " equations of motion of the spinning electron obtained in Part I [see Abstract 1502 (1936)] are criticised on the ground that, to obtain them, it is necessary to place a somewhat arbitrary restriction on the Lagrangian function. The unitary field theory is therefore altered by the assumption that the charged particles concerned have both an electric and a magnetic moment in their rest-systems. The resulting theory is mathematically more symmetrical but it is pointed out that, in fact, the elementary charged particles found in nature have no electric rest-moment. G. C. McV.

2030. New Electrodynamics. Marie A. Baudot. *Comptes Rendus*, 202. *pp.* 919–921, *March* 16, 1936.—The action functions in the Born-Infeld and Schrödinger electrodynamics are discussed. [See Abstract 2864 (1935) and following Abstract.] N. M. B.

2031. Expression of an Action Function. Marie A. Baudot. *Comptes Rendus*, 202. *pp.* 1158–1159, *March* 30, 1936.—It is shown that in the Infeld theory the Schrödinger action function is, to a close approximation, the sum of the Born Lagrangian and Hamiltonian ; the Schrödinger Lagrangian satisfies the conditions of one of the many possible Infeld action functions. [See preceding Abstract.] N. M. B.

2032. Photometric Consequences of the Einstein Deviation. F. Link. *Comptes Rendus*, 202. *pp.* 917–919, *March* 16, 1936.—The bending of light rays by the gravitational field of a massive body which they graze must also have the result of altering the intensity of the light. This effect is negligible for the case of the sun. It is pointed out, however, that it might be appreciable in the case of the occultation of one star by another. G. C. McV.

See also Abstracts 2013, 2065, 2067, 2370.

SOLUTION.

2033. Kinetics of Solution of Alkali-Boron Glasses. R. L. Müller. *Acta Physicochimica*, 4. 1. *pp.* 99–118, 1936. *In German.*—A critical examination of work done heretofore on rates of solution shows that there is almost complete lack of data on the kinetics of reciprocal action between the solvent and the substance undergoing solution. Into this group the author places the problems relating to glass-forming substances. From the completed analysis of the experimental data for the velocities

of solution of boron glasses the earlier conclusion referring to the non-diffusion on solution of glassy alkali-borates with the molar fraction $q \gg 0 \cdot 5$ is confirmed. Experimental determination of the energy of activation of solution of glassy borates gives a value of 10–15 k.cal. An attempt is made to clarify the physical nature of the energy of activation of solution. Simultaneously a definition is given for the energy of activation of the crystallisation process. From a comparison of the experimentally deduced value of C in the expression for the velocity of solution $Vm = Ce - A/T$ with the theoretically calculated values, it is concluded that the value of the coefficient according to Myamoto's theory on the solution process based on the kinetic gas theory is not applicable. The calculation of the constant C according to the adsorption theory of Frenkel and to a certain degree according to the sublimation theory of Polanzi and Wigner lead to more satisfactory results. [See Abstract 1062 (1936).] J. K.

2034. Etching Figures on Glasses. B. Markin, R. Müller and C. Weinstein. *Acta Physicochimica*, 4. 1. *pp.* 199–122, 1936. *In German.*—Twelve microphotographs are reproduced of etching figures noted on the surfaces of dissolving glasses while studying the solution of alkali-rich glassy borates, the etchings resembling corrosion figures on metals. Reference is made to the observations of Leydolt in 1852 on the etchings on glass. Silica glasses in liquid HF were found to give etching figures while polished surfaces of silica glasses do not give honeycombed surfaces. J. K.

2035. Solubility of N_2–H_2 Mixtures in Water. J. Kielland. *Am. Chem. Soc., J.* 58. *pp.* 426–427, *March*, 1936.—The total and the partial solubility in water of N_2–H_2 mixtures at pressures of from 50 to 1000 atmospheres can be calculated to within a few per cent. AUTHOR.

***2036. Absorption of Air by Mineral Oils. A. Gemant.** *Faraday Soc., Trans.* 32. *pp.* 694–701, *April*, 1936.—An apparatus and a method are described, based on the manometric principle, to measure the absorption of gases by liquids and its temperature coefficient. They are utilised here in measuring the absorption of air in mineral oils for 20° and 80° C. It appears from results obtained from different oils that the Bunsen absorption coefficient, referring to the volume unit of oil, is practically constant in the above range of temperature, the variation generally not being larger that 1 %. Thermodynamical conclusions from the above result indicate that the absorption of air in oil is followed by a first step of reversible oxidation process. Some conclusions are drawn as to the temperature variation of the electrical breakdown strength of oil. AUTHOR.

2037. Influence of Degree of Dispersion on Physico-Chemical Constants. Part VI. E. Cohen and J. J. A. Blekkingh, Jr. *K.Akad. Amsterdam, Proc.* 39. 2. *pp.* 154–163, 1936. *In German.*—The solubility of salicylic acid at 25° is found to vary considerably (0·2176–0·2379 gm./100 gm. H_2O) according to the method of preparation of the solution, *e.g.* whether the excess of acid and H_2O are merely allowed to stand in the thermostat, are shaken with small Au spheres, or filtered through varying thicknesses of cotton wool which has, or has not been already used for that purpose. Although the varying degrees of dispersion thus produced have some effect on the solubility it is shown that the greater part of the variation is due to the fact that " pure " salicylic acid contains about 0·2 % of the more soluble parahydroxyhenzoic acid. [For Part V see Abstract 424 (1936).] C. A. S.

SURFACE TENSION AND COHESION.

***2038. Surface Tension Measurements of Viscous Liquids. A. H. Pfund and E. W. Greenfield.** *Indust. & Engin. Chem.* (*Analytical Edition*), 8. *pp.* 81–82, *March* 15, 1936.—A small air jet impinging perpendicularly on the surface of a liquid produces a small stable depression whose depth a is measured by a horizontal short-focus telescope. Measurements with water, glycerol, glycol, dibutyl phthalate and two oils gave the empirical relation $T = K\sqrt{a}$ where K is a constant for a given jet, air pressure, and distance between the jet and the undisturbed surface. This method can be used for determining T and is particularly applicable to viscous liquids which cannot be dealt with satisfactorily by most other methods. It is suggested that interfacial tensions could conveniently be measured in the same way. The air jets are sensitive to short sound waves and this effect is well adapted for demonstration. P. H. B.

2039. Surface Tension of Soap Solutions. N. K. Adam. *Faraday Soc., Trans.* 32. *pp.* 653–656, *April*, 1936.—The effects of slight traces of alkali in raising the surface tension of soap solutions are explained as due to suppression of hydrolysis, which is very much magnified in the surface layers, since the surface activity of the acid, or acid soap, is very much greater than that of neutral soap. The adsorption of neutral potassium laurate is calculated from published data, and the adsorbed film is found to be gaseous, of the usual type. AUTHOR.

2040. Mechanical Strength of an Alumina Skin, and its Effect on the Surface Tension of Molten Aluminium. A. Portevin and P. Bastien. *Comptes Rendus*, 202. *pp.* 1072–1074, *March* 23, 1936.—The strength is determined by two methods—(a) An Al wire is suspended vertically and heated by a small flame moved along it ; rupture takes place when the weight of the molten metal exceeds the resistance of the Al_2O_3. (b) An Al wire supported at its ends and hanging freely is heated by an electric current. By varying the width of the catenary formed and noting its dimensions at the moment of rupture, the weight supported by the Al_2O_3 is deduced. Both methods give a value of 1960 dynes per cm. for a film formed as a result of heating for about 1 min. at 700° C. approx. A film thickness of 10^{-5} cm. is deduced from the weight of Al_2O_3 remaining after volatilisation of the Al in dry Cl_2, giving a tensile strength of 2 kg./(mm.)^2, much higher than that of crystalline Al_2O_3. A value of 840 dynes per cm. is obtained for the surface tension on a large drop of Al in air. By forming an argon bubble within molten Al, a value of 300 dynes per cm. for a clean surface was obtained, agreeing satisfactorily with that calculated from the parachor. By forming a large drop of Al in a molten cryolite medium, a value of 420 dynes per cm. was obtained. The latter is regarded as an upper limit for a clean Al surface. D. R. H.

2041. Electrocapillary Curves of Gallium. Part II. A. Murtazajew and A. Gorodetzkaja. *Acta Physiocochimica*, 4. 1. *pp.* 75–84, 1936. *In German.*—A survey is made of the electrocapillary curves of fluid Ga in N KCl solution and in solutions of a few capillary-active substances. The maximum boundary surface tension of Ga|N KCl corresponds to a potential of 0·9 V against a normal calomel electrode and is 613·3 and 608·2 dynes/cm. (2 samples). These values are somewhat higher than those previously found (592). [See Abstract 3353 (1928)]. The investigated capillary-active substances namely phenol, iso-amyl alcohol, pyrogallol, thiourea and KI displace the maximum of the electrocapillary curve of Ga in the same direction as that of Hg. The degree of adsorption,

however, is different for the two cases; the adsorption by Ga leads to a much greater negative charge on the metallic surface than by Hg. The calculation of the capacity of the electrical double layer at a negative charge from the descending portion of the electrocapillary curve gives for one sample of Ga $24\mu F/cm.^2$ and for another sample $17\mu F/cm.^2$ J. K.

See also Abstracts 1933, 2000, 2047.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

***2042. Piezoelectric Chronograph. E. P. Tawil.** *Comptes Rendus*, 202. *pp.* 1016–1017, *March* 23, 1936.—If a birefringent crystal vibrates the change of birefringence due to strain can be used to investigate the frequency of vibration. Two crossed quartz crystals are used and when the piezo-electric crystal vibrates part of the luminous flux will be transmitted. Its magnitude depends on the amplitude of the vibration. This has been examined by reception on a photographic film travelling at 100 m./sec. Frequencies of 2×10^5/sec. can thus be investigated and measured.

R. S. R.

VACUA, HIGH.

***2043. High-Vacuum Pumps. W. Kerris.** *A.T.M.* 5. *T25–T26*, *Feb.*, 1936.—Contains a survey of the various types of high-vacuum pumps, including rotary oil pumps and diffusion pumps, and mentions their more important properties. Typical speed curves are given, which show that most diffusion pumps give a maximum speed at pressures of the order of 0·001 to 0·0001 mm. mercury. G. E. B.

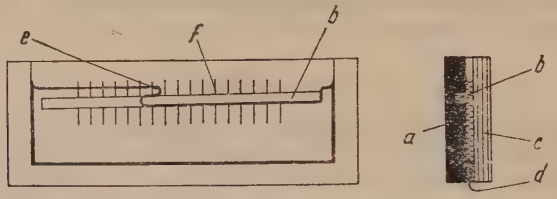
***2044. Vacuum Pumps and Pump Oils. Part I. Fractionation Pumps. K. C. D. Hickman.** *Frank. Inst., J.*221. *pp.* 215–235, *Feb.*, 1936.—Discusses certain anomalies in the behaviour of diffusion pumps. In the case of mercury-vapour pumps the observed ultimate vacuum is of the same order as the vapour pressure of the mercury, but in the case of pumps having butyl phthalate or Apiezon oils this limit is not reached. It is suggested that this is due to the presence in the oil of both light and heavy constituents, which may be produced by the heating or by electrical discharges. The presence of such impurities, even in minute quantities, seriously affects the action of the pump, since the action is selective. Further, the process of contamination is aggravated by the action of the pumps. This point was verified experimentally, and it was found that all pumps were not equally susceptible. Finally, a brief account of a new type of multi-stage pump is given, which is so designed that the fractionation of the liquid assists rather than hinders the pumping action. G. E. B.

***2045. Vacuum Pumps and Pump Oils. Part II. Comparison of Pump Oils. K. C. D. Hickman.** *Frank. Inst., J.* 221. *pp.* 383–402, *March*, 1936.—The properties of various pump oils are discussed. The higher phthalate esters, while apparently having unsuitable properties proved to be quite good in practice, probably because of the absence of air and water-vapour. One of the chief defects of oil as compared with mercury as a pumping fluid is the ease with which the oils are spoiled by the accidental entry of gas. This deterioration is shown to take place in 2 stages, and if the heat is switched off at once, the fluid is, in general, not completely spoiled. Summarising, the highest vacuum was obtained with Apiezon A, amyl phthalate or hexyl phthalate cooled with solid CO_2. Without a trap, the highest vacuum was obtained with octyl phthalate. In all cases the pumps attained vacua approaching the vapour pressure of

the fluid at the room-temperature. Notes on the design of heaters and jets are appended. G. E. B.

***2046. Limitations of Tubular Ground-Glass Joints. A. M. Skellett.** *Rev. Sci. Instruments*, 7. *pp.* 179–180, *April*, 1936.—A consideration of the stresses involved in ground-glass joints when used in vacuum apparatus indicates that the weakest part of such a joint is the wall of the outer member. For dependable large joints all the dimensions should be increased proportionally. After grinding it is suggested that the surfaces be etched slightly to relieve strains. AUTHOR.

***2047. New Capillary Phenomenon and its Application to Micro-Manometric Measurements. E. Röbbelen.** *Zeits. f. techn. Physik*, 17. 3. *pp.* 95–98, 1936.—The new capillary phenomenon consists in the form of the meniscus of a liquid contained in a cell (see figure) having two parallel plates with a groove *b*. If the liquid does not wet the glass, the



form of the meniscus is as shown. Used as a manometer, the groove takes the shape of a screw thread between two glass cylinders. The upper end of the cylinders is connected to the vacuum, and the liquid is drawn up the thread. The kink in the meniscus provides a very sensitive indicating point, and the manometer may be calibrated to be direct-reading to 0·01 mm. of the liquid if this has normal densities. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

2048. Viscosity Formula for Binary Mixtures (Summary). T. Ishikawa and T. Baba. *Chem. Soc., Japan, Bull.* 11. *pp.* 64–101, *Feb.*, 1936.—The probable values of the normal K (which signifies the ratio of the characteristic constant of component 2 to that of 1, in the formula for chemically indifferent mixtures: $\eta = \eta_1/[1 + Kzm/(1-zm)] + \eta_2/[1 + (1-zm)/Kzm]$ relative to that of benzene are now considered from the available data [see Abstract 1514 (1936)]. Eight formulæ are considered *viz.* the one above, which is an ideal mixture law, and 7 modifications of it to account for actual mixtures. From probability considerations the conception is derived that a molecular compound is not a fast-combined molecule but a molecular grouping in a statistical meaning. One of the formulæ when applied to the viscosity which exhibits a very marked maximum at low temperatures appears to afford a clue for the study of the mechanism of crystal formation. The various cases of a strong electrolyte solution, where solvation and hydration do and do not occur, are shown to be accounted for by the respective modified formulæ. The solutional viscosity of a solid in a liquid is the viscosity probably due to the block of a secondary structure in accordance with the secondary structure theory on crystals when the substance is an organic non-electrolyte, or is the viscosity due to the ionic pair when the substance is an ionic crystal. The solutional state of an electrolyte which is composed of its ionic pairs behaves like a liquid containing no molecular aggregates. H. H. Ho.

2049. Viscosity of Suspensions. Part I. E. Guth. *Kolloid Zeits.* 74. *pp.* 147–172, *Feb.*, 1936.—A theoretical paper in which are discussed the hydrodynamic principles underlying the determination of viscosity of suspensions, with particular reference to the work of Einstein on suspensions and the Jeffery theory of ellipsoid suspensions. [See following Abstract.] J. K.

2050. Viscosity of Suspensions. Part II. W. Krasny-Ergen. *Kolloid Zeits.* 74. *pp.* 172–178, *Feb.*, 1936.—A formula is derived for electroviscosity, based on that of Smoluchowski, and it is shown that while this derived formula is suitable for relatively good conductors, it does not hold good for insulating fluids. [See preceding and following Abstracts.] J. K.

2051. Viscosity of Suspensions. Part III. E. Guth and R. Simha. *Kolloid Zeits.* 74. *pp.* 266–275, *March*, 1936.—It is shown that the influence of the wall on a rotating sphere is smaller than on a translatory moving sphere, in agreement with the work of H. Przibram. The results obtained are also given for the influence of the wall on a sphere in a pure dilatation current and the reciprocal action between two rotating spheres. [See preceding and following Abstracts.] J. K.

2052. Viscosity of Suspensions. Part IV. F. Eirich, M. Bunzl and H. Margaretha. *Kolloid Zeits.* 74. *pp.* 276–285, *March*, 1936.—The investigations show that the Einstein relationship $\eta = \eta_0(1 + 2{\cdot}5v/V)$ deduced from purely hydrodynamic considerations applies well to those systems which conform to certain stipulated assumptions. [See preceding Abstract.] J. K.

2053. Viscosity of the Critical Mixture of the Ternary System Benzene-Alcohol-Water. O. Kimura. *Chem. Soc. Japan, Bull.* 11. *pp.* 57–63, *Feb.*, 1936.—Experimental details are given for the determination of the viscosity of the three component system benzene-ethanol-water near the critical point. It is found that Andrade's formula is strictly applicable to the homogeneous region but not to the colloidal zone. The latter deviation is due to the colloidal particles whose concentration is calculated by means of Hatschek's formula and found to be of the order of 0·0001 near the critical point. H. H. Ho.

2054. Viscosity of Oxygen Gas at Low Temperatures. A. van Itterbeek and (Miss) A. Claes. *Physica*, 3. *pp.* 275–281, *April*, 1936. *In French.*—Measurements are made on the viscosity of O_2 at 293·8°, 90·1°, 79·8° and 72·0° K. by the oscillating disc method. At 293·8°, 90·1° and 72·0°, by observing the logarithmic decrement of the oscillations, the dependence of viscosity on pressure or density for a pressure range from 76 cm. to about 10^{-5} mm. is determined. No dependence on pressure is found for pressures down to about 5 mm. For smaller pressures down to about 0·1 mm. there is a great decrease. At still lower pressures the logarithmic decrement becomes a linear function of the density. This may be explained by the fact that at sufficiently low pressures the mean free path of the molecules becomes greater than the dimensions of the apparatus. From these experiments can also be calculated the ratio of the mean velocities of the molecules at 293·8°, 90·1° and 72·0° K. The values obtained are in agreement with those derived from the Maxwell-Boltzmann velocity distribution within the limits of the possible errors. AUTHORS.

2055. Viscosities of Liquid Refrigerants. J. H. Awbery and E. Griffiths. *Phys. Soc., Proc.* 48. *pp.* 372–380, *May* 1, 1936.—The

viscosities of sulphur dioxide, ethyl chloride, methyl chloride, cis-dichlorethylene, trans-dichlorethylene, trichlorethylene and dichlor-difluormethane are measured at temperatures between $-15°$ and $+30°$ C. The method used is that of timing the rate of fall of a closely fitting plug in a vertical tube filled with the liquid. In order to avoid evaporation, with the resultant formation of bubbles, an auxiliary reservoir of the fluid is connected with the experimental tube; the refrigerant in the reservoir is maintained at a temperature slightly above that of the tube, so that the pressure in the apparatus is above the vapour pressure of the liquid in which the plug moves. In all cases the viscosity η is found to follow a law $\eta = Ae^{a/T}$ where T is the absolute temperature and A and a are constants. AUTHORS.

2056. Effect of an Electric Field on the Viscosity of Liquids. E. D. Alcock. *Physics*, 7. *pp.* 126–129, *March*, 1936.—Previous investigators have found that an electric field changes the viscosity of some liquids. This paper deals with this effect of an electric field on the viscosity and some of the factors upon which it is dependent. A rotating cylinder type of viscosimeter is used, the two cylinders being insulated from each other and the potential applied between them. Several liquids are investigated, some polar and some non-polar. Non-polar liquids showed zero effect, while polar liquids showed effects which were dependent on their polar moment. Changes in viscosity up to 200 % are measured using fields up to 2000 V/cm. It is also found that the effect is dependent on the velocity gradient present in the liquid. AUTHOR.

2057. Electron Diffraction Analysis of the Orientation of the Molecules of Lubricating Oils. L. T. Andrew. *Faraday Soc., Trans.* 32. *pp.* 607–616, *April*, 1936.—An electron diffraction method for investigating the molecular orientation and hence the boundary lubricating properties of lubricating oils is described. The results obtained are found to be in reasonable agreement with those actually obtained in practice. In the process of the experiments, some of the commoner defects of lubricants, such as oxidation and corrosion, are also investigated. AUTHOR.

See also Abstracts 1926, 1969, 1982, 1996, 2000, 2088, 2294, 2303.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2058. Errors of Setting in Photographing Spectra for Radial Velocity Measurement. G. Järnefelt.** *Soc. Scien. Fennica, Comm. Phys. Math.* 8. 22. [10 *pp.*], 1935.—In photographing stellar spectra, it is recognised to be of great importance to set the centre of the star image as accurately as possible on the centre of the slit, or the lines will be unsymmetrical. For the spectrograph of the Helsingfors Observatory an apparatus has been designed and made which records the setting by photographing the star image on the slit at the same time as the star spectrum. The apparatus is described and discussed. M. A. E.

***2059. New f/0·36 Object-Glass for Stellar Spectroscopy. R. J. Bracey.** *Astrophys. J.* 83. *pp.* 179–186, *April*, 1936.—A great increase in the speed of spectrographic camera lenses was obtained by W. B. Rayton, who enlarged eight-fold and suitably modified a 16-mm. and a 4-mm. microscope objectives and thus produced lenses of aperture ratios *f*/2 and *f*/0·6 with a useful focal length for astronomical work. The present paper gives an account of a similar modification of a 2-mm. immersion microscope objective which yields a lens having the aperture ratio of *f*/0·36. An immersion fluid which can be placed in contact with the photographic emulsion has been found, which permits the use of ordinary photographic plates. AUTHOR.

***2060. Ultra-Violet Stellar Spectra with Aluminium-Coated Reflectors. Part IV. R. W. Shaw.** *Astrophys. J.* 83. *pp.* 225–235, *April*, 1936.—The ultra-violet spectrum of α Boötis is investigated between λ3950 and λ3150. Nearly all of the 336 lines measured are identified. Important lines of Al, Cr and Cu are observed. Fe and Ni have a number of complete multiplets the characteristics of which are admirable for intensity work. Much of the general decrease in intensity of the u.v. region may be due to the strong resonance lines of Ni, Ti and V. Na is characterised by the second principal series doublet at λ3302. It is suggested that this pair of lines may be useful in studies of interstellar matter. The NH molecular spectrum at λ3360 was identified and shown to be free from serious blending except for the Ti^+ line at λ3361. Suggestions as to the importance of this band in astrophysical work are made. The use of the words near, far, and extreme, as related to u.v. stellar work, is discussed in a note. It is suggested that near refer to the region from H and K to λ3650, that far refer to the region from λ3650 to λ2950, and that extreme refer to all regions beyond λ2950. AUTHOR.

***2061. Fine-Grain Developer for Spectrographic Photography. W. W. Morgan.** *Astrophys. J.* 83. *pp.* 254–255, *April*, 1936.—A fine-grain developer of the physico-chemical type using metol, glycin, and para-phenylene-diamine as developing agents has been found to give stellar spectrograms on the fastest commercial emulsions of a quality almost equal to those taken on Process plates. The saving in exposure time with the fast plates is very great. AUTHOR.

COSMOGONY.

2062. Relativistic Theory of the Expanding Universe. P. Y. Chou. *Chinese Journ. Phys.* 1. *pp.* 1–17, *Oct.*, 1935. *In English.*—The gravitational field and the motion of matter in the universe are investigated according to Einstein's field equations and his dynamical equations of motion. In a spatially isotropic and homogeneous space-time continuum it can be shown that up to about 2×10^8 light-years the following relation holds between spectrum displacement $\delta\lambda$ from distant spiral nebulæ and their observationally defined distance d, $\delta\lambda/\lambda = \sqrt{\Lambda/3}.d(1 + \sqrt{\Lambda/3}\cdot d)$, where Λ is Einstein's cosmological constant. The first term on the right hand side is essentially Hubble and Humason's velocity-distance relation. The second part is a correction which amounts to 11·5 % for $d \sim 2 \times 10^8$ light-years, and hence lies within observational error of the present Mt. Wilson 100-inch telescope. The theory shows that both Milne's recent Newtonian theory of the expanding universe and Lemaître's interpretation of the velocity-distance are first order approximations and are valid only within 2×10^8 light-years from our galaxy. The calculation for the phenomena of nebular recession beyond 2×10^8 light-years to be observed by the 200-inch telescope now under construction according to the present scheme will be presented in the near future. AUTHOR.

2063. Expanding Universe. E. Reichenbächer. *Zeits. f. Astrophysik*, 11. 3. *pp.* 192–200, 1936.—It is suggested that, amongst the expanding universes of general relativity, those in which the total mass of the universe is proportional to the radius are the most satisfactory from the physical point of view. G. C. McV.

2064. Size and Age of the Universe. J. Jeans. *Roy. Inst., Proc.* 29. 1. *pp.* 65–86, 1936. *Nature*, 137. *pp.* 17–27, *Jan.* 4, 1936. *Supplement.* —The author traces the attack on this problem from Pythagoras, Heraclides and Aristarchus, who held views analogous to Copernicus (the Ptolemaists in between being reactionary), and then to Newton's system of the world. He then proceeds with the apparent magnitudes of the stars, through the δ Cepheids (which bring in the extra-galactic nebulæ), to the apparent magnitudes of the nebulæ themselves, and these extend the visible size of the universe to the distance of 150 million light years. The relativity theory brings in the curving back of this space on itself and from it that the number of the nebulæ should increase less rapidly than the cube of the distance, though probably the contrary is the case. For the age of the universe he deals with the recession of the nebulæ, inferring that 2,800 million years ago, its size was about a quarter of what it is now, but states that it cannot have been expanding for more than 100,000 million years; and he suggests a previous period of contraction. He finally turns to the motions of the stars and the equipartition of energy as containing a more convincing argument. A. S. D. M.

2065. Milne's Cosmological Theory. H. Dingle. *Philosophy*, 11. *pp.* 1–12, *Jan.*, 1936.—The logical basis of Milne's theory is examined. The basis of the special theory of relativity is first developed, and it is pointed out that the Doppler effect can be used to define a rigid measuring rod. Examination of Milne's theory for reducing all space measurements to time measurements then shows that Milne cannot define relative motion unless he makes additional assumptions which, in fact, reduce his theory to special relativity. Again, an analysis of Milne's cosmological principle shows that his "equivalent" observers must be supposed capable of

transmitting not only signals, but also ideas, across space. The author contends that, in fact, Milne in his theory never uses the " equivalence " of two observers but endows them with atomic clocks which are assumed, and not proved, to be "equivalent." Thus, in effect Milne has only one observer in the universe who makes use of exactly the same procedure as is pre-supposed in special relativity. G. C. McV.

2066. Galactic Dynamics and Cosmic Time Scale. B. J. Bok. *Observatory*, 59. *pp.* 76–85, *March*, 1936.—The approximate equipartition of energy for stars of various spectral types has been regarded as supporting a long time scale of order 10^{13} years. It is shown that the distribution of the directions of space motions, the results of a galactic rotation, and certain striking exceptions to the rule deprive it of much of its value for this purpose. Another argument for the long time scale is the rate of disintegration of moving clusters. The author shows on assumptions which tend to minimise the disintegration that the disappearance of these clusters is to be expected in a paradoxically short time and that a renewal of the phenomenon is not to be expected ; he gives reasons for regarding their age as identical with that of the galaxy and concludes that they support the short time scale of 10^{10} years. It is also shown that the persistence of spiral arms over the longer time is unlikely. Other arguments for the short time scale are summarised. T. L. M.

2067. Foundations of Dynamics. E. A. Milne. *Roy. Soc., Proc.* 154*A*. *pp.* 22–52, *March* 2, 1936.—In Milne's theory of the universe there exists a natural origin for the reckoning of time, a characteristic velocity at each point of space, and a cosmical acceleration for any free particle. The object of this paper is to examine what modifications in the classical laws of dynamics are suggested by these characteristics of the universe. Newton's First Law may be replaced by a statement of the cosmical acceleration for the free particle, and the Second Law by a definition of external force in terms of the difference between the observed acceleration of the constrained particle and the corresponding cosmical acceleration. Using a simple kinematic model for the universe, it is shown that to a Newtonian degree of approximation external force is equal to the rate of change of the momentum of a particle relative to its immediate cosmical surroundings. The inertial mass of a particle is of the form $M = m\Omega/c^2$, and the energy is of the form $E = Mc^2 = m\Omega$, where Ω is the kinetic potential of the smoothed-out matter of the universe, and is a known function of the epoch, position and velocity of the particle concerned. For local rest the energy becomes mc^2, and for an observer near the particle E and M reduce to the ordinary Einsteinian expressions. The increment of E measures the external work performed along any *constrained* path, and E is constant for a *free* particle. Moreover, the cosmical acceleration of a free particle is gravitational in character, Ω obeying Poisson's equation near any observer, and γ, the constant of gravitation, can be calculated in terms of the matter and motion in the universe. A. J. McC.

2068. Kinematics and World-Structure. Part II. H. P. Robertson. *Astrophys. J.* 83. *pp.* 187–201, *April*, 1936.—The equations of motion of a test particle in an idealised universe satisfying the cosmological principle are obtained from the standpoint of the general kinematics developed in Part I [see Abstract 4892 (1935], and are found to be determinate only to within an arbitrary function Γ of two variables. Their integration is reduced, in principle, to the solution of a single first-order ordinary differential equation. The acceleration function Γ is determined

and the integration completed upon imposing (*a*) the general relativistic theory of gravitation, thus showing the consistency of the general kinematics here developed with that theory, and also upon imposing (*b*), any suitable adaptation of the Newtonian theory of gravitation, illustrated in detail by a relativistic extension applicable to the case in which the total mass of the fundamental particles (nebulæ) is finite. AUTHOR.

See also Abstract 2071.

LATITUDE AND LONGITUDE.

2069. Variation in Latitude with Moon's Position. S. Kawasaki. *Imp. Acad., Tokyo, Proc.* 11. *pp.* 398–400, *Dec.*, 1935. *In English.*—A continuation of the investigations by Kimura, Shida, Przbyllok and Nishimura for the years 1912–1931. The author has made plots on squared paper of the mean observed values of latitude for each month, and from a smoothed curve has found daily corrections, obtaining small resultant latitude residuals. These are grouped for each observation according as the moon is south or north of the equator, and each group is again arranged with respect to the corresponding moon's hour angle. Tables are given, but the author fails to detect Stetson's large range (0″·07) of lunar diurnal variation in latitude, which may however be concerned with an annual term, and may therefore introduce a false lunar correlation with latitude. It is necessary on this account to eliminate all systematic terms of long period from the observed latitude values, before investigating the moon's effect. A. S. D. M.

NEBULÆ.

2070. Nebulosity Near Omicron Persei. J. P. Reimer. *Akad. Wiss Wien, Ber.* 144. 2*a*. 7–8. *pp.* 497–505, 1935.—The paper reports on star counts in the immediate neighbourhood of Omicron Persei, based on Vienna astrographic plates. The distinct dark cloud effects reduce the light of more distant stars by 1·4 magnitude; this nebulosity is certainly nearer than 100 parsecs. The part of the Taurus cloud in this area absorbs 1·5 magnitudes, and stretches between 270 and 550 parsecs. The bright nebulosity appears to form part of both absorbing areas, rendered luminous by adjacent stars. The results are applied to discuss the limiting value of the absorption factor in the luminosity function: previous estimates seem too great. T. L. M.

2071. Nebular Redshift. R. J. Kennedy and W. Barkas. *Phys. Rev.* 49. *pp.* 449–452, *March* 15, 1936.—The possibility of an effect of the free electrons in a highly ionised gas on the frequency of light traversing it is investigated. Electrons to a density of about 5×10^{12} per cc. are produced in a series of l.v. arcs Light of wave-length 5461 Å is passed through the arcs and a frequency shift sought by means of an interferometer *in vacuo*. A shift of approximately two parts in 10^{10} could have been detected. A very satisfactory null result was obtained. This is interpreted with special reference to the possibility of explaining the nebular redshift by such a mechanism. It is concluded that the shift is not attributable to interstellar electrons. AUTHORS.

See also Abstract 2064.

PLANETS.

2072. Simplified Model of Planetary System. N. Moissejev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 2. *pp.* 67–68, 1936. *In German.*—Two finite masses move in circular Keplerian orbits round their common centre of gravity. In their plane are also a number of thin concentric circular rings. The resulting system of equations leads to an integral of the type of Jacobi's in the restricted problem. But if inclination and eccentricity can be neglected, the rings can be submitted for the planets, by a theorem of Gauss ; this simplified dynamical model may have useful applications to certain problems of secular perturbations. T. L. M.

See also Abstracts 2069, 2175.

STARS.

2073. Formation of Stellar Absorption Lines. P. Swings and O. Struve. *Astrophys. J.* 83. *pp.* 238–244, *April*, 1936.—Microphotometer measures of the total absorptions of lines of O II within the wing of Hγ, and of CαH within the wing of Hϵ, show departures from the normal absorptions predicted from the multiplet intensities of these lines. The departures increase with the wing absorption, but the effect is more pronounced for OII and for CaH. Eddington's theory of absorption lines leads to a theoretical evaluation to the effect. The remaining discrepancies between this theory and actual observation are unexplained. AUTHORS.

2074. Zanstra's Theory and Be-Type Stars. D. Barbier. *Zeits. f. Astrophysik*, 11. 3. *pp.* 185–191, 1936. *In French.*—Mohler's temperatures for Be stars calculated on Zanstra's theory, are in accord with the colour temperatures on the scale of Greaves, Davidson and Martin. It is now shown, however, that if the variation in the absorption coefficient of hydrogen and in particular, the discontinuity at the limit of the Lyman series, be taken into account then the temperatures are sensibly greater than the colour temperatures. This leads to the conclusion that Unsöld's theory of the photosphere is at fault, and that Kosirev and Chandrasekhar's extended photosphere theory is more satisfactory for this type of star. G. C. McV.

2075. Polytropic Equilibrium. Parts I to III. E. A. Milne. *Roy. Astron. Soc., M.N.* 96. *pp.* 184–218, *Jan.*, 1936.—In the usual studies of polytropic equilibrium the pressure at any level in the stellar model is assumed to counterbalance the weight of the superimposed layers, the outer boundary of the model being at the level where there is no longer any matter and where the temperature is zero. The author now considers the more general problem of polytropic equilibrium when the pressure at a given level is allowed to vary arbitrarily. Under these conditions it is possible, by suitable choice of this pressure, to show that polytropes for $n=3$ can have zero or infinite radii, and also, when $n>3$, that there are two values of the radius for a given applied pressure. The theory is then applied to the problem of determining the character of the model when the applied pressure is that due to the photosphere, the latter being calculated independently. Amongst other results it is deduced that the luminosity of a star varies as the cube of its mass, a result in agreement with observation. The author concludes with a general statement of his views regarding the problem of stellar structure and of the results achieved so far. He stresses

in particular the conclusion that the theory of stellar structure can only give the mean value of the opacity coefficient in the photospheric layers of the star, and not the mean value throughout the whole star.

G. C. McV.

2076. Occurrence of Electron Degeneracy in Interior of a Star. P. ten Bruggencate. *Zeits. f. Astrophysik*, 11. 3. *pp.* 201–220, 1936.—The Rosseland transformation of the fundamental equations of stellar constitution leads to the physical interpretation of the different types of solution and also of the degeneracy conditions. The paper discusses mainly the latter question by methods which bring out the physical implications. The author uses the standard model and sets up the fundamental equations, examining the character of the solutions (M, E and F) which involve no surface singularity, for the perfect gas, classical degeneracy, and relativistic degeneracy. The physical possibility of M and F solutions is discussed. The degeneracy condition of Sommerfeld is applied to the various solutions. It is then possible to derive conditions for zones of degeneracy. In particular it is shown that under certain conditions a zone of complete relativistic degeneracy can adjoin the perfect gas zone. T. L. M.

2077. Equilibrium of Stellar Atmospheres under a Temperature Gradient. R. Wildt. *Mt. Wilson Observat. Contrib. No.* 538. *Astrophys. J.* 83. *pp.* 202–215, *April*, 1936.—If the temperature gradient maintained by the radiation flux is smaller than the adiabatic gradient of the stellar matter and, therefore, is not sufficient to set up convection currents, the constituents of the atmosphere will be separated partially by diffusion. For all constituents participating in processes of dissociation or ionisation there are remarkable deviations from the well-known exponential distribution of the partial pressures (depending only on the molecular weight), the additional terms containing the space derivatives of the thermodynamical equilibrium constants. The kinetic equivalents to these terms are stationary diffusion currents, which transport reaction energy and increase the heat conductivity, although there is no net flux of mass. This diffusion equilibrium may be realised in the atmospheres of early B stars and of stars between the types G_5 and M, which ought to be free from convection. AUTHOR.

2078. Existence of Obscuring Matter in Vicinity of Solar System. A. Corlin. *Zeits. f. Astrophysik*, 11. 3. *pp.* 221–259, 1936. *In English.*—An investigation following the work of Schalén on a near obscuring cloud, but valid for the whole sky. The author uses Charlier's system of 48 equal galactic squares, and employs two independent methods: (*a*) parallax stars of 10–50 parsecs distance taken from Schlesinger's Catalogue of parallaxes; and (*b*) by mean reduced parallaxes from Boss's Preliminary General Catalogue. In both $\Delta M = M - \bar{M}$ ($\bar{M}$ being the mean value valid for the whole sky), gives a positive difference for maximum obscuration in galactic squares C7–C11 (Argo, Centaurus and Scorpius, where is the local cluster centre), and negative in the opposite direction; but nothing similar is found for other squares for near distances. This phenomenon cannot be attributed to systematic errors, to differential galactic rotation, or other dynamical circumstances, but only to obscuration increasing towards the centre of the local cluster. He points out possible consequences as regards comets and meteors. A. S. D. M.

2079. Fourth-Magnitude Eclipsing Star. S. Gaposchkin. *Harvard Coll. Obs., Bull. No.* 902. *pp.* 17–22, *Feb.* 1, 1936.—On the basis of

376 estimates on Harvard patrol plates, spread over twelve years (1922–1934), it is found that 29 Canis Majoris is an eclipsing star with two almost equal minima ($0^m.33$). The spectroscopic and photometric observations are in agreement if the larger, more massive, and more luminous component is eclipsed at first minimum. The evaluation of the inclination of the orbit leads to the conclusion that the larger component of the system is the most massive star known among eclipsing stars, having forty times the solar mass. AUTHOR.

2080. Variable Stars of Short Period. Part III. Cluster Variable RR Geminorum. S. Gaposchkin. *Harvard Coll. Obs., Bull. No.* 902. *pp.* 22–24, *Feb.* 1, 1936.—A photographic light curve is derived from 150 observations of RR Geminorum. The range and brightness are very close to the determinations of other observers. The light curve has a sharp maximum. It is not possible to represent all observed maxima distributed over the interval of 34 years by a linear system of elements; the sine term derived by Zessewitsch gives good agreement between the predicted maxima and the maxima observed at Harvard. [For Part II see Abstract 2453 (1935).] AUTHOR.

2081. Spectrum of the Super-Nova S Andromedæ. Cecilia P. Gaposchkin. *Astrophys. J.* 83. *pp.* 245–251, *April*, 1936.—According to the synopsis of contemporary spectroscopic observations given in the present note, the spectrum of S Andromedæ contained bright lines, which presented little contrast to the background even when the continuous spectrum had grown comparatively faint. It is concluded that the spectra of super-Novæ (so far as the existing observations go) are not essentially different from those of more ordinary Novæ, although the details are very different, and far larger velocities are probably involved. AUTHOR.

2082. Possible Interpretation of the Absorption Spectra of Nova Herculis. W. W. Morgan. *Astrophys. J.* 83. *pp.* 252–253, *April*, 1936.—Two sets of diffuse absorption lines present in Jan., 1935, in the spectrum of Nova Herculis may be interpreted as originating from the two visual components discovered by Kuiper. The radial velocity of the stronger component is −850 km./sec.; that of the weaker, +1090 km./sec. The Balmer series from $H\beta$ to $H\epsilon$ and Fe II 4924 show both components. If the spectral interpretation is correct, the brighter visual component is approaching and the fainter is receding from the earth. In later stages of the spectrum of the Nova the double emission lines may also be considered to have originated in the visual components. As the separation of the emission components is less than that of the earlier absorption spectra, a negative acceleration of the two visual components must be assumed. AUTHOR.

2083. System of the HDC Durchmusterung Magnitudes. A. N. Vyssotsky. *Astrophys. J.* 83. *pp.* 215–224, *April*, 1936.—The photovisual magnitudes of 2730 stars between the 8th and 11th magnitudes and north of −30°, derived at the McCormick Observatory, were used as a standard system with which to compare the BD, SD, and CoD magnitudes reduced to the HDC system by means of the tables in *Harvard Annals*, 72, Nos. 6 and 7 (referred to as HDCDM system). Next, the HDCDM magnitudes were compared anew with the photovisual magnitudes derived by Miss Payne in Harvard standard regions A, B, C and D, and with the photovisual magnitudes derived by Ross and Zug for the Eros comparison stars. Finally, they were compared with the photovisual magnitudes determined at the Mount Wilson Observatory in the zone north of +80°.

All four comparisons, in agreement with the conclusion of Seares, Sitterly, and Joyner, show that the scale correction to reduce the HDCDM magnitudies to the IPv system is negligibly small. When the various photovisual magnitudes are reduced to the zero point and to the colour of the IPv system, the HDCDM magnitudes are well represented by the formula : IPv = HDCDM + $0^{M}.15 - 0 \cdot 2$ C.I. Since the mean colour index for the stars between the eighth and eleventh magnitudes is about $0^{M}.6$, this indicates that, on the average, the correction on the right-hand side of the equation is practically zero. [See also Abstract 4142 (1935).] AUTHOR.

See also Abstracts 2032, 2058, 2060, 2066, 2070, 2175, 2176, 2195.

SUN.

2084. Scale of Wave-Lengths in the Infra-Red Solar Spectrum. H. D. Babcock, Charlotte E. Moore and W. P. Hoge. *Mt. Wilson Observat. Contrib. No.* 534. *Astrophys. J.* 83. *pp.* 103–120, *March*, 1936.—Interferometer measurements made in 1927 have in some cases been slightly improved in relative value without systematic change of scale. Similar new observations extend the scale to λ 10603. Standards of reference have been chosen from the A band of atmospheric O_2 as previously determined from Ne standards. With the concave grating alone provisional standards are measured as far as λ 12103 in terms of adopted solar standards in the visual region by the method of overlapping orders. Methods of reduction are described, and tables for finding the correction due to observer's motion relative to the sun are given. Results include 249 lines, of which 142 are telluric. The accuracy of the wave-lengths when tested indirectly by means of a much larger collection of data based on these standards, is found to be decidedly higher than that of most laboratory data in the infra-red, and even well beyond λ 10000 the wave-lengths appear to be reliable to about 1 part in a million. AUTHORS.

See also Abstracts 2032, 2100, 2175, 2195.

GEOPHYSICS.

GEODESY.

2085. Azimuths from Plane Coordinates. O. S. Adams. *Coast and Geodetic Survey, Serial No.* 584. [14 *pp.*], 1936.—Methods, both approximate and exact, are worked out for finding the true azimuth of a line in a traverse survey from the plane coordinate grid. W. A. R.

GEOPHYSICS, APPLIED.

2086. Geophysical Prospecting. E. Lancaster-Jones. *Phys. Soc., Reports,* 2. *pp.* 97–128, 1935.

2087. Theoretical Determination of Earth Resistance from Surface Potential Measurements. A. F. Stevenson. *Phil. Mag.* 21. *pp.* 829–830, *April,* 1936.—A correction [see Abstract 1525 (1935).]

2088. Physics in the Oil Industry. P. D. Foote. *Physics,* 7. *pp.* 91–96, *March,* 1936.—A short review of the work of the physicist in the oil industry from geophysical prospecting to the refinery. W. A. R.

See also Abstract 2116

HYDROSPHERE, PHYSICS OF THE.

2089. Changes in Mean Sea Level at Brest and Marseilles. V. Frolow. *Comptes Rendus,* 202. *pp.* 908–910, *March* 16, 1936.—The mareographs at Brest and Marseilles show variations in mean sea level with a general tendency to rise at the rates of 12 and 8 cm. per century respectively. Harmonic analysis points to periodic fluctuations of periods, of 2, 3, 4, 5·7, 11·3 and 18 years, and perhaps of 36–45 years, with variations of phase and amplitude, differing in amount for the two places. It is suggested that while the observations are not inconsistent with a secular rise in sea-level, the fluctuations may be merely the result of variations in the rates of evaporation and river flow. [See Abstract 4527 (1935).] C. A. S.

2090. Annual Oscillation of Mean Sea-Levels at Brest. J. Legrand. *Comptes Rendus,* 202. *pp.* 911–912, *March* 16, 1936.—The fluctuations in sea-level as recorded by the mareograph at Brest during the years 1845–1932 are analysed harmonically. The results are shown graphically, and seem to imply variation in the components over the period. [See Abstract 3287 (1929).] C. A. S.

2091. Colour of Crater Lake Water. E. Pettit. *Nat. Acad. Sci., Proc.* 22. *pp.* 139–146, *Feb.*, 1936.—The lake, 6177 ft. above sea level, is in the crater of an extinct volcano, and its waters appear a deep blue in colour. A blue appearance arises from scattered light, and from an examination of the physical and chemical state of the lake, it seems that the scattering here is due to the water molecules and any modification introduced by reflection at the surface. Comparison tests on scattering made on different water samples point to the condition in Crater Lake as approximating very closely to that found in the case of settled ocean water. Spectroscopic examination of the scattered light has also been carried out, comparison being made with a spectrum of direct light after passage through the same amount of water. The results for both Crater Lake

water and dust-free water are given in tabular form and show close agreement. The colour of the lake viewed from different points and under different meteorological conditions is also referred to. The author therefore concludes that the predominant colour is due to multiple scattering by water molecules, while superposed on this are the effects of reflection of clouds, sky and crater walls. A. E. M. G.

LAND, PHYSICS OF THE.

2092. Comparison of Statically and Dynamically Determined Young's Modulus of Rocks. J. M. Ide. *Nat. Acad. Sci., Proc.* 22. *pp.* 81–92, *Feb.*, 1936.—Young's modulus, E., is determined by the method previously described [see Abstract 4468 (1935)] with the same samples of rock as used by Zisman [see Abstract 4418 (1933)] for statical determinations and some others, 54 samples in all, of 12 varieties. The cylinders measured $25 \times 5{\cdot}08$ and $20 \times 1{\cdot}59$ cm. (in several cases samples cut at three mutually $\perp$ directions were examined). E as determined with the longer cylinders averaged some 4 % $>$ with the shorter. The values of E determined dynamically (E_d) averaged 4–20 % $>$ those (E_s) determined statically, though in some cases the difference was much greater—33, 87 and 27 % in one limestone and two gneisses respectively. Theoretically the difference should be $\gtrsim 0{\cdot}3$ %. That it is so much larger is due to the presence of minute cracks and cavities which affect E_s much more than E_d. E_d in different samples of the same rock usually varied $\gtrless$ as the density. In some cases variation with direction was considerable—30 % in a dolomite. With proper selection of the samples E_d agreed more closely with E as deduced from seismological observation than E_s. C. A. S.

2093. Helium Ratios of Rocks and Minerals from Diamond-Pipes of S. Africa. A. Holmes and F. A. Paneth. *Roy. Soc., Proc.* 154*A*. *pp.* 385–413, *April* 1, 1936.—In order to determine the relative ages and probable origins of the xenolithic inclusions in the kimberlite pipes of S. Africa the He, U and Th contents of 23 samples were determined. The method used was as previously [see Abstract 2429 (1928)] with refinements enabling amounts of 10^{-5} to 10^{-8} cc. to be measured. The He was extracted either by fusion with Na_2CO_3 or by heating to 800°–900°. The results are consistent with the Cretaceous age of the kimberlite and of the alteration of some of the xenoliths having occurred then, but point to the eclogites and also the appinites and hornblende gneiss being probably much older, possible pre-Cambrian, crustal rocks, and (the eclogites) not the result of differentiation from the original kimberlite magma. It is probable that the peridotites and zircons also are older and lost He when incorporated in the kimberlite magma. C. A. S.

See also Abstract 1989.

METEOROLOGY.

2094. Temperatures and Constituents of the Upper Atmosphere. D. F. Martyn and O. O. Pulley. *Roy. Soc., Proc.* 154*A*. *pp.* 455–486, *April* 1, 1936.—Observations on the upper atmosphere have shown that the ionised layer at 250 km. moves bodily during the night. In the present paper the authors deal with the results of a series of radio observations carried out with the object of ascertaining the cause of this variation. The method of observation is first described and thereafter the results are set out and discussed. Between the E-(100 km.) and F-(250 km.) layers of the ionosphere, temperatures of the order of

1000° K. are found to exist, the temperature in F, the upper layer, being higher than that in E. From the rate of cooling at night which is considerable, water vapour is found to be present in this region to the extent of 1 in 6000 by volume. The high temperatures are attributed to the absorption of u.v. energy by ozone. Further a direct correlation appears between the " ionisation " densities in the E- and F-regions and the barometric pressure at the surface. This is accounted for by changes in ozone concentration. Observation requires that the number of free electrons in the E- and F-layers be roughly constant throughout the night. A mechanism whereby this result can be attained is given. This view is supported by Rayleigh's observations on the intensity of the green line of the night sky. An examination of the temperature distribution below the E-layer shows a maximum about 60 km. and a minimum about 82 km. The temperature distribution from the surface up to 300 km. is shown in graphical form. A. E. M. G.

2095. Sorption of Radon by Aerosols. O. Macek. *Gerlands Beitr. z. Geophys.* 46. 4. *pp.* 353–365 *and* 455–456, 1936. *English Abstract.*—Experiments on the " sorption " of radon on aerosols are communicated. The percentage of the absorbed atoms of radon amounts—with increased contents of nuclei—(motor-exhaust- and flame-gases)—to about 2 %. It is also found that more radon atoms are " sorbed " on charged aerosols than on electrically neutral ones. Theoretical considerations show that " sorptions " in the observed amounts cannot be explained by assuming pure adsorption (surface effects). There must rather be assumed an absorption of the radon atoms by the aerosols. On account of these considerations and experiments the doubts of Israël-Köhler [see Abstract 4937 (1934)] about the correctness of the determinations of the radon-concentrations, as measured by the usual direct methods, seem to be definitely refuted. Author.

2096. Attachment of RaA, RaB, and RaC to Dust Particles. G. Rosa. *Gerlands Beitr. z. Geophys.* 46. 4. *pp.* 394–399, 1936. *In Italian.*—Aliverti's method of measuring the presence of radioactive elements in the atmosphere, leads to the result that nearly all the products of Rn are linked with dust particles. Since this method is not above reproach, the air is examined by first freeing it from dust and then introducing Rn. The stability of the equilibrium between the Rn and its product is then examined. Full details of this are given. The conclusion is that some of the products of disintegration are attached to the dust particles, but the ratio N_e of the atoms of Rn deposited to N_d of the atoms measured direct is 37 %, so some of its products cannot be attached to dust particles since they are lost from the stream before they are formed. [See following Abstract.] H. M. B.

2097. Adsorption of Radon on Aerosols. H. Israël-Köhler. *Gerlands Beitr. z. Geophys.* 46. 4. *pp.* 413–417, 1936.—The probability of the attachment of Rn to artificial and natural aerosols can be taken as certain. The use of proportional number tubes is recommended to determine the quantitative relation of adsorption. The various methods and results [see Abstract 141 (1936)] are discussed and the conclusion that Rn is never adsorbed by atmospheric dust particles, as maintained by G. Rosa [see preceding Abstract], is dismissed. H. M. B.

***2098. Transmission of Heat by Convection from Insolated Ground to the Atmosphere. P. K. Raman.** *Indian Acad. Sci., Proc.* 3*A*. *pp.* 98–106, *Feb.*, 1936.—This paper first describes a simple

apparatus designed to determine the rate at which heat is transferred from dry ground to the atmosphere, and used during January–May, 1935. Results of experiment show that if the excess temperature of the ground is more than 10° C. heat loss due to convection shows considerable fluctuation. The mean rates of heat loss are grouped according to wind velocity at 4 ft. and the ratio of the rate of loss of heat to the temperature difference between the ground and air at 4 ft. tabulated. For velocities less than 5 m./s. the formula $H/\theta = 0088 + 0056$ v. has been used, calculated values and observed values showing good agreement. In the region considered (Poona) the average daily quantity of heat transferred to the atmosphere by convection is calculated and found to be about 250 cal. This addition of heat is sufficient to explain why cold spells due to cold air coming down in the wake of depressions end in two or three days provided there is no further advent of cold air. A. E. M. G.

2099. Daily Change of Temperature. R. Spitaler. *Gerlands Beitr. z. Geophys.* 46. 4. *pp.* 400–404, 1936.—The temperature decreases during the night until dawn, when it suddenly begins to rise reaching its maximum value in the afternoon. A formula is obtained [see Abstract 563 (1936)] depending upon the position on the earth, the height of the sun and the radiation from it. The heat entering the earth's atmosphere from the sun and the heat given to it by the earth are considered and the formula is finally corrected by a sine factor. Tables show the hourly radiation in Berlin and the constants for the variation in temperature during the year. H. M. B.

2100. Half-Yearly Period of Air Pressure. F. Reuter. *Gerlands Beitr. z. Geophys.* 46. 4. *pp.* 366–393, 1936.—In the tropics the half-yearly pressure waves are known to depend upon the radiation of the sun but in the sub-tropics, the temperate and polar zones, these waves have not so marked a reality. The pressure curves are analysed over 10, 20 and 30 year periods from 1891 by Shujter's method and Bartel's period clock and diagrams are given to compare the yearly systematic oscillations of the pressure waves at various stations. It is seen that the sunspot waves correspond in period and amplitude with the pressure waves. H. M. B.

2101. Lunar Atmospheric Tide at Glasgow. S. Chapman. *Roy. Soc. Edinburgh, Proc.* 56. 1. *pp.* 1–5, 1936.—Reasons are given for believing that the lunar hourly inequalities of barometric pressure at Glasgow recently published by Robb and Tannahill are substantially not of lunar origin at all. An earlier determination of the lunar atmospheric tide at Glasgow made in 1926 by Robb is, however, now published with his permission, and appears to be a true lunar effect. It indicates that at Glasgow the lunar atmospheric tide is abnormally small for the latitude; the phase seems normal, and corresponds to a lag of high tide on the atmosphere of less than one hour after lunar transit. [See Abstract 3809 (1935).] Author.

2102. Reflection and Absorption of Daylight at the Surface of the Ocean. W. M. Powell and G. L. Clarke. *J.O.S.A.* 26. *pp.* 111-120, *March*, 1936.—Previous investigations of submarine illumination indicated large surface losses of light. The present observations were undertaken (1) to ascertain the cause of these losses, and (2) to determine the effect of different conditions of sky and sea on their magnitude. The relationship between the incident, absorbed and 'lost' light is given by $I = A + (R + U)$, R denoting the light reflected at the surface and U the part entering

but reflected out again. I was determined, then (R + U) and hence A found, photoelectric photometers being used. A full description is given of the practical arrangements. In the table showing the results obtained, mainly in Buzzards Bay, (R + U) is given as a percentage of I for both violet and red regions. A minimum value of 3 to 4% is obtained on clear days when the sun is nearest the zenith. This increases slightly when waves are present and when the sky is cloudy. The greater part of the "surface loss" is accounted for by the air bubbles present in a surface layer about 1m. thick. A. E. M. G.

***2103. Photomagnetron for Measurement of Twilight Brightness. A. Dauvillier.** *Comptes Rendus*, 202. *pp.* 738–740, *March* 2, 1936.—A full description is given of a type of apparatus in which magnetic modulation in the cell itself is employed instead of using a mechanical arrangement to interrupt the luminous flux. A much greater sensitivity is obtained in this way. The apparatus is similar to Hall's magnetron. It has been used during the winter at Abisko in studying the law of auroral phosphorescence and later at Meudon for registering the intensity of the green ray in the night sky. The results are to be published later. It can also be used with much higher magnetic field frequency in the electric transmission of images [See Abstract 5231 (1933).] R. S. R.

2104. Radiations beyond λ3000 in the Night-Sky Spectrum; Probable Existence of Two Luminescent Layers in the Upper Atmosphere. J. Cabannes, J. Dufay and J. Gauzit. *Comptes Rendus*, 202. *pp.* 612–614, *Feb.* 24, 1936.—At the short-λ end of the night-sky spectrum, where O_3 absorption is considerable, three emission lines are observed [see Abstract 197 (1935)] at λλ 3019 (strong), 2969 (weak and somewhat doubtful) and 2958 (fairly strong). It is supposed that they originate in the same region of the O_3 layer. λ 2958 and λ 2969 are identified as the O lines $^1S_0 \rightarrow {}^3P_2$ and $^1S_0 \rightarrow {}^3P_1$, which are expected in the night sky from the presence of $^1S_0 \rightarrow {}^1D_2$ (λ 5577) and whose calculated λλ are 2958·3 and 2972·4. There are probably two luminescent layers, the higher one being excited directly by elctronic collision and the lower one being due to transitions accompanying the formation or the destruction of O_3. The metastable $^1S_0$ atoms of O result from the decomposition of O_3 :—$O_3 \rightarrow O_2(^1\Sigma) + O(^1S_0)$. Recent observations of the periodic variations of the brightness of the night sky are explained on this hypothesis. W. J.

***2105. Energy Distribution in Night-Sky Spectrum. V. I. Cerniajev, I. A. Khvostikov, and K. B. Panschin.** *J de Physique et le Radium*, 7. *pp.* 149–152, *March*, 1936.—The threshold method of visual perception was used in the Caucasus to obtain with a monochromator the nocturnal variation of intensity of the light. The apparatus used is described. Tests were made over the range 4550 to 5900 Å with six series of observations each night. The results are tabulated and shown graphically. It is found that the spectral composition and intensity both vary during the night. The effects are subdivided between (1) energy from stars assuming a blackbody temperature of 5500° Abs. and having a constant value, (2) diffused solar light from the upper atmosphere layers which from King's curves has a constant value, and (3) nocturnal diffusion over the range 5300–5900Å. The results are tabulated and the absolute intensity of the green ray is found. The latter is near to, but smaller than, Rayleigh's value. R. S. R.

2106. Northern Lights. A. S. Eve. *Roy. Inst., Proc.* 29. 1. *pp.* 166–188, 1936.—*Received March*, 1936.—After referring to the nature of the lower air

and the passage of an electric discharge through it, the author turns to consider the upper atmosphere and the auroral displays which become possible there owing to the rarified state of the air. The average height and the different forms of, together with the occasional sounds supposed to accompany, auroral displays, are dealt with in turn. From the spectrum of the aurora, the presence of certain gases is proved. The effect of the earth's magnetic field on the position of the auroral displays is then discussed. The influence of such displays on weather is regarded as negligible. The author then proceeds to consider the various methods employed in revealing the composition and structure of the upper atmosphere. Special reference is made to the E- and F- layers. Attention is drawn to the relation between sunspots, auroral displays and magnetic storms. Meteors also are seen to contribute special information regarding the state of the upper atmosphere at certain levels. Diagrams and photographs are reproduced to illustrate particular points. A. E. M. G

***2107. Single-Hair Hygrometer. W. G. Iles and Kathleen Worsnop.** *Phys. Soc., Proc.* 48. *pp.* 358–371, *May* 1, 1936.—A sensitive single-hair hygrometer is described which enables observations to be carried out, over an extended range, on the effects due to variations in relative humidity and in temperature. The temperature coefficient of a stretched hair in an atmosphere kept at a relative humidity of 100 % is negative for temperatures above about 1·5° C. and positive in the range below that temperature. If the hygrometer is kept at a constant temperature and the relative humidity of the air is decreased from 100 % there is an immediate increase in length, corresponding to an apparent increase in relative humidity of about 3 %, followed by a contraction to the equilibrium length characteristic of the lower humidity. It seems probable that this effect may account for the apparent supersaturation sometimes seen in balloon meteorograph records. With this hygrometer the scale value for relative humidity was dependent on temperature. The lag in response of the single hair is often considerable. It has its maximum effect when humidity is varying rapidly as in a rising balloon, but is of much less importance on the ground, since there conditions alter relatively slowly, and the hair will always be in approximate equilibrium with the air surrounding it. Authors.

***2108. Thermocouples for Psychrometric Purposes. R. W. Powell.** *Phys. Soc., Proc.* 48. *pp.* 406–414, *May* 1, 1936.—The paper deals with certain factors affecting the use of thermocouples for psychrometric purposes, and considers some of the advantages possessed by instruments of this type. An investigation is made for the purpose of determining the manner in which the wet-bulb depression depends on the degree of ventilation, the diameter of the wire, the thickness and length of the water film covering the junction of the wet thermocouple, and the relative positions of the wet and dry thermocouples. It is shown that the need for forced ventilation of the wet thermocouple decreases as the diameter of the wetted wire is diminished. A typical example is given showing that for a psychrometer composed of nichrome and constantan wires of 40 s.w.g. mounted in a still air enclosure, the percentage relative humidity derived from its readings is only two or three units greater than that given by a fully ventilated instrument, when psychrometric tables appropriate to the latter condition are used in each instance. Author.

See also Abstracts 2091, 2112, 2288.

SEISMOLOGY.

2109. Free Motion of the Surface of a Semi-Infinite Elastic Solid. S. Syôno. *Geophys. Mag., Tokyo.* 9. *pp.* 285–298, *Dec.*, 1935. *In English.*—In Lamb's treatment of this problem he assumed a concentrated force. This is shown to lead to untenable results in certain circumstances. The free motion of a surface is here worked out without adopting the assumption of a concentrated distribution. W. A. R.

2110. Velocity of P-Waves in the Earth Calculated from the Macelwane P Curve, 1933. C. G. Dahm. *Seismological Soc. of America, Bull.* 26 *pp.* 1–11, *Jan.*, 1936.—The Macelwane P curve is based on the data of the Tango, Hawke Bay, and Long Beach earthquakes, all of 10–12 km. focal depth. This curve was modified and adjusted to fit a spheroid of 6355 km. radius, the outer part of which has the same properties as those immediately under the Mohorovičić discontinuity in Japan. The original and the adjusted P curve are given as well as the velocity-depth and depth-distance data obtained by applying the Herglotz-Wiechert method to the adjusted P curve. The inversion and slight decrease of the velocity-depth function at 2730 km. depth are discussed and the continued validity of the Herglotz-Wiechert method under those circumstances is shown. Author.

2111. Magnitude and Energy of Earthquakes. B. Gutenberg and C. F. Richter. *Science*, 83. *pp.* 183–185, *Feb.* 21, 1936.—The authors point out the necessity of grading earthquakes in catalogues according to the magnitude of the shock. Indiscriminating use of instrumental data gives undue weight to minor shocks. Using their own arbitrary scale, they find that in California the minor shocks account only for a very small part of the liberated energy. The smaller shocks do not appreciably mitigate the strains which are released in the larger earthquakes, but must be regarded as minor incidents in and symptoms of the accumulation of such strains. W. A. R.

2112. Microseisms and Meteorological Conditions. D. C. Bradford. *Seismological Soc. of America, Bull.* 26. *pp.* 29–53, *Jan.*, 1936.—The present paper deals with the theory which attributes the origin of microseisms having periods of from 2 to 7 sec. to barometric oscillations. For this purpose a table has been constructed from records of microseismic amplitudes and periods taken at St. Louis, together with a record of the number of lows, their intensities and positions, in North America, both groups for the period November, 1933–March, 1934. The lows are divided into types. From the investigation the author finds (1) that the various types of low vary in their degree of correlation with microseismic displacements; (2) that the period of microseisms tends to vary with amplitude; and (3) that microseisms are under the direct influence of changing meteorological conditions. He concludes, therefore, that the type and intensity of lows are the main factors in the propagation of microseisms. A. E. M. G.

2113. Strength and Rigidity of Wooden Floors as Diaphragms. T. C. Combs. *Seismological Soc. of America, Bull.* 26. *pp.* 55–61, *Jan.*, 1936.—The deflections of wooden floor panels subjected to a uniformly-distributed load are given, and a curve plotted showing the effect of the ratio of length to breadth. Miscellaneous results of other experiments on wooden floors are given. R. F. A.

2114. Vibration of Steel Water-Towers. R. S. McLean and W. W. Moore. *Seismological Soc. of America, Bull.* 26. *pp.* 63–67, *Jan.*, 1936.—The computed periods of vibration of a lattice tower are brought nearer to the observed if all tie-rods are assumed operative, the previously-assumed compression or buckling effects in one set being in fact merely reductions in tension. The effects of varying the height of the water in the tank are also discussed. R. F. A.

2115. Vibration of Steel Water-Towers. D. S. Carder. *Seismological Soc. of America, Bull.* 26. *pp.* 69–88, *Jan.*, 1936.—Vibration-records were made on thirty-seven towers, and the effects of foundation, degree of bracing, tension of tie-rods, quantity of water, wind-velocity, and a side-load (applied through a wire link calibrated to break at, say, 2000 lb.) were studied. Three types of vibration were observed : (i) that of the tank-tower system with a frequency of about 1·6 sec., (ii) short " riders " of 0·38 sec. due to torsional oscillations of the tank, and (iii) a long-period (3 sec.) vibration thought to be due to movements of the water in the tank. Beats of 23 sec. period were also observed, which are shown to be due to the union of " tank-tower " vibrations with vibrations caused by the surging of the water. The period of the tower is reduced by additional bracing or tightening of loose tie-rods, and depends on the amplitude when some of the rods are loose. Towers on piling in soft ground had generally longer periods than those on firm ground. R. F. A.

2116. Problems and Progress on the Geologico-Seismological Frontier. J. B. Macelwane. *Science*, 83. *pp.* 193–198, *Feb.* 28, 1936. The origin of earthquakes is first discussed. It is shown that the long waves of natural earthquakes are suitable on account of their wave-length only for the study of the coarser crustal structure or large scale layering and not for fine scale structure. A review is given of many results on the thickness and depth of the crustal layer at different places, its complexity, and the depths of the Mohorovičić and Repetti discontinuities. Finally the source of the energy of earthquakes is discussed and the physical conditions in the core. R. S. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2117. Discontinuity in Negative Conductivity of Atmospheric Air at a Front. G. Schou. *Gerlands Beitr. z. Geophys.* 46. 4. *pp.* 418–437, 1936.—Examples of conductivity, potential, pressure, wind strength and direction are given for days of ordinary and thunder storms, when cold or warm fronts are passing. It is found that a discontinuity in the negative electrical conductivity λ- appears as the ground front passes in a cold front, but earlier in a warm front. If two fronts follow quickly on one another the second discontinuity is the greater, the first being disturbed by the proximity of the second. When a front is near a centre of high or low pressure the effects are more marked. The discontinuity in λ- is independent of the precipitation and may arise from the positive ions being carried to the earth by the descending air currents. H. M. B.

2118. Small Local Rapidly Periodic Magnetic Fluctuations. F. Menaw. *Terr. Mag.* 41. *pp.* 1–8, *March*, 1936.—A discussion of terrestrial magnetic fluctuations with periods ranging from a few sec. to several min. and of as yet unrecognised source. An alternating magnetic doublet is supposed to be at a height h above the earth's surface and to set up a magnetic field over an area small enough to be regarded as plane. The

disturbance is found to extend over an area of radius not much exceeding 2 *h*. The discussion leads to a complete knowledge of the strength and position of the doublet. G. E. A.

2119. Geomagnetic Coordinates for the Entire Earth. A. G. McNish. *Terr. Mag.* 41. *pp.* 37–44, *March*, 1936.—Formulæ used in calculating the geomagnetic coordinates are given in terms of the coordinates of the geomagnetic pole and the geographical coordinates of any point. Nomographs are constructed and shown which give (1) geographic and geomagnetic coordinate-systems for the entire earth, (2) corrections to give geomagnetic latitude and longitude for various values of geographic latitude and longitude, and (3) the angle between the geographic and geomagnetic meridians for various values of the geographic latitude and longitude. Instructions are given for the use of the nomographs and examples are supplied. Finally the method of obtaining geomagnetic time is described. R. S. R.

2120. Auroral and Magnetic Activities. C. C. Ennis. *Am. Geophys. Union, Trans. pp.* 165–168, 1935. *Terr. Mag.* 41. *pp.* 45–55, *March*, 1936.—Instead of correlating coincident values of auroral intensity and of magnetic declination only, as was done in a prior investigation by the author, use is made of corresponding values of horizontal intensity also. The " disturbing force " (amount and direction) is computed for each half-hour during the day for June, July, and August (incomplete) from " normal-day " departures of observed values of declination and horizontal intensity. The results are classified according to the presence or absence of auroræ. Represented by a series of graphs, they show interesting contrasts and similarities with respect to the two classes. Of special note is an outstanding post-midnight maximum in the disturbing force, occurring consistently, from the standpoints of time and magnitude, but only when auroræ are present and at a time of day when auroral intensity is at about its daily minimum. Another feature revealed by vector-diagrams of the disturbing force is the two-loop, day and night characteristic. AUTHOR.

2121. Thunderstorms as a Cause of Earth Currents. K. Terada. *Geophys. Mag., Tokyo*, 9. *pp.* 269–278, *Dec.*, 1935. *In English.* —Six different ways are stated by which electric charges may pass to the earth from the atmosphere, by three of these positive charges are brought, by the other three negative. The approximate times during which electricity is brought down by each of these methods are calculated. This calculation, along with the distribution of methods according to latitude, enables the quantity brought down in each latitude to be arrived at. At the poles a positive charge enters, at the equator a much greater negative charge, the unequal distribution being mainly due, according to the author, to the point discharge currents from thunderstorms. The actual value of earth current obtained from these charges, however, is very small, so that unsettled weather conditions do not account for the whole earth current. But over a region where the specific conductivity is high it is pointed out that such conditions may contribute a fair proportion of the total.

A. E. M. G.

See also Abstracts 2094, 2106, 2173, 2436, 2437.

RADIOACTIVITY.

2122. General Theory of Fluctuations in Radioactive Disintegration. A. Ruark and L. Devol. *Phys. Rev.* 49. *pp.* 355–367, *March* 1, 1936.—The chance that n atoms will disintegrate in the interval (o, t) may be found if $f_r(t)dt$, the chance that a disintegration will occur in dt at t after r have occurred in (o,t), is known. Bateman's differential equation is generalised to cover the case in which f_r depends on t and r. The solution is given for the case in which it depends only on t. The problem of determining fluctuations in the disintegration of a single substance from fluctuations in counting is solved for the case in which each disintegration gives a single ray capable of actuating the counter. Fluctuations in counts produced by two or more independent sources are considered, and the distribution of counts due to γ- and β-rays and the effect of the recovery time of the counter are discussed. Formulæ are derived for the stock fluctuations of each substance in a source containing several members of a radioactive series. General methods for finding the fluctuations in the emission of an entire radioactive series, or any part of a series, are given. W. E. P.

2123. Radioactivity of Samarium. R. Hosemann. *Zeits. f. Physik*, 99. 5–6. *pp.* 405–427, 1936.—A new method, utilising a comparison with a Po source, is described for the measurement of ranges of α-particles from weak radioactive sources. A method is also described for distinguishing, by means of a Wilson chamber, between low intensity α-particles and protons. The α-particles from Sm have a range of $1{\cdot}13 \pm 0{\cdot}02$ cm. in air at 15° C. and 760 mm. Hg. One gm. of Sm emits 89 ± 5 particles per sec., giving a half-value period of $(1{\cdot}00 \pm 0{\cdot}07) \times 10^{12}$ years. All the particles from Sm observed in the cloud chamber were α-particles, and if protons are emitted, they must have an intensity less than 5 % of that of the α-particles. The results of other workers are discussed and compared with the present work, the agreement being satisfactory, and it is suggested that the radioactive properties of Sm are now well established. J. E. R.

2124. Calorimetric Measurements of Disintegration Energy in the Actinium Series. A. Sanielevici. *Comptes Rendus*, 202. *pp.* 1055–1057, *March* 23, 1936.—The thermal effect of the radiation from Ac in equilibrium was determined by absorption in Al. That due to the α- and recoil particles, E $(\alpha + r)$ is 7·15 cal./gm./hr, that to the β-and part of the γ-rays, E $(\beta + x\gamma)$ 0·28. Similarly by extrapolating the results of absorption in Pb of varying thickness the thermal effect of the radiation from Ac → Ac C″, the superior limit of E$(\beta + \gamma)$ is shown to be 10 % of E$(\alpha + r)$. From the heat output of the radiation of Ac (B + C + C″) and the number and known energies of the α-particles the mean energy of the β-rays of Ac B is $3{\cdot}7 \times 10^5$ eV, and the heat evolution in Ac C → Ac C″ is thus distributed : $(\alpha + r)$ 90·9 %, primary β 2·4, and secondary β and γ 6·7 %, while calculation based on the α fine structure of Ac C → Ac C″ [see Abstract 3464 (1933)] gives 2 % of E $(\alpha + r)$ as the maximum of the γ-energy corresponding to excitation of the nuclei consequent on emission of the less rapid α-particles. C. A. S.

2125. Properties of Radioactive Series. E. Lopoukhin. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 27–33, 1936. *In French.*—With the help

of recent models of the nucleus it is shown that the series of radioactive elements exhibit three consecutive phases of disintegration. In addition to these, certain other formal conditions are established for determining the course of α- or β-disintegration. [See also Abstract 584 (1936).]

N. M. B.

2126. Lead-Uranium Ratio of a Siliceous Pitchblende. J. P. Marble. *Am. Chem. Soc., J.* 58. *pp.* 434–437, *March*, 1936.—A sample of pitchblende from LaBine Point, Echo Bay, Great Bear Lake, N.W.T., Canada, yields a "corrected" lead-ratio of 0·193, corresponding to an age of 1323 million years. As the atomic weight and isotopic composition of the lead, and the Pa/UI ratio of this same sample have been determined, ages, etc., calculated by different methods should agree. This agreement is not obtained in all instances, and possible reasons are outlined. The age found indicates that a possible Keewatin granite may be the source of the pitchblende. AUTHOR.

2127. Decomposition of Magnetic Spectrum of ThC into Two Series. S. Rosenblum. *Comptes Rendus*, 202. *pp.* 943–946, *March* 16, 1936.—The existence of the group α_5 of the fine structure of ThC is discussed and failure by some observers [see Abstract 2828 (1934)] to detect it attributed to its weakness. Arguments based on regularities in the energies of it and the other α groups are adduced pointing to the intrinsic probability of its existence as a member of the series including also α_0, α_2 and α_4, the other groups of this spectrum forming a second series.

C. A. S.

2128. Deviation of β-Rays by Nitrogen Nuclei. M. Lecoin. *Comptes Rendus*, 202. *pp.* 839–840, *March* 9, 1936.—Considering only deviations of more than 10° in the trajectories of β-rays in N_2 the values of $(E_1-E_2)/E_1$, where E_1 and E_2 are respectively the energies before and after deviation, have been determined for 90 cases occurring in some 1500 m. of trajectories. As the value of $(E_1-E_2)/E_1$ increases the number of cases exhibiting that value decreases. The number showing a large loss of energy, such as that reported by Leprince-Ringuet [see Abstract 5217 (1935)] is very small and only about 1/20th theoretical. The effective cross-section of the N nucleus deduced from these results is about 1×10^{-23} cm^2. for collisions involving small losses of energy and 10^{-24} for those involving large losses, both figures considerably higher than in accord with present theory. C. A. S.

2129. Continuous Spectrum of Actinium B. M. Lecoin. *Comptes Rendus*, 202. *pp.* 1057–1059, *March* 23, 1936.—By the method previously described [see Abstract 3409 (1935)] the spectral distribution of the β-rays from Ac B (accompanied by 20 % Ac C″) is determined. Corrected for the presence of this latter a curve is obtained showing a maximum for 5×10^5eV and an upper limit to the spectrum of $9{\cdot}5 \times 10^5$eV. C. A. S.

***2130. Quantitative Estimation of Radon. H. Mache.** *Akad. Wiss. Wien, Ber.* 144. 2*a*. 9–10. *pp.* 595–605, 1935.—The problem of the accurate estimation of Rn is considered in detail from a theoretical standpoint. A condenser discharge apparatus is described and the precautions adopted are discussed. Curves and tables showing the results obtainable are given. J. E. R.

***2131. Measurement of Small Quantities of Radon. H. Garrigue.** *J. de Physique et le Radium*, 7. *pp.* 107–109, *Feb.*, 1936.—The author describes a light, portable and robust apparatus for measuring the Rn content of air. The air is introduced into a previously evacuated

cylindrical vessel containing an insulated charged rod. The fall in potential of the rod due to the ionisation produced by the Rn is measured by a small Coulomb balance. W. E. P.

***2132. Apparatus for Direct Determination of Radon in Water and Air. F. Běhounek.** *Phys. Zeits.* 37. *pp.* 203–208, *March* 15, 1936. —The paper first describes apparatus for determining the concentration of Rn in water. The sample is drawn into a vertical cylinder (0·25 l.) which is connected with the ionisation chamber through a tap and a small tube. The water is atomised as it emerges from the tube and the expelled emanation is drawn into the ionisation chamber. The latter is connected to a Lindemann electrometer, provided with a projection system, the scale of which is calibrated in Mache units, two ranges 0 to 70 and 0 to 700 Mache units being available. A portable apparatus incorporating a Lindemann electrometer and a compensating device is also described for the direct determination of Rn in samples of air. W. E. P.

***2133. High-Speed Counting of Electrical Impulses. J. Barnóthy and M. Forró.** *Phys. Zeits.* 37. *pp.* 208–211, *March* 15, 1936. —Various methods of high-speed counting of electrical impulses which depend upon recording only every nth impulse have been described [see Abstracts 1968, 3948, 4292 and 4294 (1934)], but for very high rates of counting the apparatus becomes cumbersome. The present paper describes a simple method in which the impulses are applied to the grid of a valve which is heavily negatively biassed. The resulting pulses of anode current continually charge a condenser in parallel with which is a gas discharge lamp. The constants of the circuit can be arranged so that for every n impulses the condenser voltage rises sufficiently to cause a discharge in the lamp. The lamp discharges can be counted electrically with a mechanical counter or, for still higher counting speeds, by actuating a second discharge lamp with a repeat of the above circuit. J. E. R. C.

***2134. Measurement of Strong α-Ray Sources. R. Garnier.** *J. de Physique et le Radium*, 7. *pp.* 110–112, *Feb.*, 1936.—In the apparatus described, the light emitted by a ZnS screen due to the action of the α-particles from the source, falls on a photoelectric cell, the current in which is amplified by a two-stage amplifier. The results of the calibration of the apparatus for sources having intensities up to 15,000 e. s. u. are given. W. E. P.

See also Abstracts 1908, 1910, 1911, 2015, 2093, 2095, 2096, 2097, 2322, 2337.

RADIATION.

ABSORPTION AND TRANSMISSION.

2135. Absorption of Monochromatic Light in Iodine Vapour. J. Harding. *Phil. Mag.* 21. *pp.* 773–778, *April*, 1936.—The absorption of the Hg lines λ 5461 and λ 4358 in I_2 vapour is measured up to a vapour pressure of about 2·5 cm. The absorption in both cases is directly proportional to the pressure. The absorption of λ 5461 is increased in the presence of He, but that of λ 4358 is not. No appreciable part of the absorption is due to adsorbed films on the windows. AUTHOR.

See also Abstract 2164.

COLORIMETRY.

See Abstract 2183.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2136. Kerr Effect and Molecular Association in the Benzol Derivatives. N. Dallaporta and G. Dascola. *N. Cimento*, 13. *pp.* 1–10, *Jan.*, 1936.—The constants of the ellipsoids of optic anisotropy for methyl- and chloro-derivatives of benzol are calculated from the constants of the Kerr effect and the factors of depolarisation of the molecules in the gaseous state after Stuart's method. The ratio between the theoretical Kerr constant K and its value obtained experimentally for the liquid is found to be approximately constant. The value of K decreases from 28° to 94°C, when measured by a method used previously [see Abstract 2502 (1935)]. From the result the influence of molecular association is obtained from the Kerr effect. H. M. B.

2137. Magneto-Optical Dispersion of Acetyl Acetone. Luq Shiueq-Shann. *Chinese Journ. Phys.* 1. *pp.* 54–58, *Oct.*, 1935. *In English.*—The magneto-optical dispersion of acetyl acetone is measured in a magnetic field of about 6000 gauss in intensity and 4cm. in length. Absolute values of the Verdet constant for the substance are obtained. Discrepancies in the values of e/m and the atomic specific rotations calculated from the data are explained. AUTHOR.

2138. Magnetic Rotatory Power of Nitric Oxide. H. Bizette and B. Tsaï. *Comptes Rendus*, 202. *pp.* 648–649, *Feb.* 24, 1936.—NO has a negative Verdet constant and its rotation is therefore inverse to that of O_2. W. R. A.

2139. Magnetic Rotatory Power of Water. R. de Mallemann, P. Gabiano, and F. Suhner. *Comptes Rendus*, 202. *pp.* 837–838, *March* 9, 1936.—Briefly describes the method used for the determination of Verdet's constant for water in which a copper voltameter is used to measure the current, the measurements being made with the mercury green line, 5460Å. The results obtained give Verdet's constant at 11·5° as $1{\cdot}543 \times 10^{-2} \pm 0{\cdot}001$ which, for the sodium D line, results in the value $1{\cdot}312 \times 10^{-2}$. R. C. F.

See also Abstract 2154.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2140. Mechanism of Fluorescence Quenching in Solution. J. Weiss and H. Fischgold. *Zeits. f. phys. Chem.* 32. *Abt. B.* 2. *pp.* 135–138, 1936.—Fluorescence quenching in solution can be regarded as an electron transfer from the quenching to the quenched fluorescent molecule (F*). For example: $F^* + Fe^{2+} = F^- + Fe^{3+}$, $F^* + Hal^- = F^- + Hal$, and the quenching in a heterogeneous system such as the surface of a metal, thus $F^* + Pt \rightarrow F^- + Pt^+$. This last, according to the authors' view, gives the explanation of the photovoltaic effect in solution of fluorescent dyestuffs. Taking the reactions: absorption $F \xrightarrow{K_1} F^* + h\nu$; emission $F^* \xrightarrow{K_1} F + h\nu$; quenching $F^* + Fe^{2+} \xrightarrow{K_2} F^- + Fe^{3+}$; it may be shown that $[F^*] = K_1 I \text{ abs} \cdot /\{I + TK_2[Fe^{2+}]\}$, where $K_1 I \text{ abs}$ = no. of excited molecules existing per sec., Iabs = absorbed intensity, I/K^1, = T = life of excited state (in absence of quencher), and square brackets imply concentration. The velocity constant K_2 can be calculated by Gurney's method $K_2 \propto e^{(E_F + Nh\nu - I_{Fe^{2+}} - X)/RT}$, where E_F is the electron affinity of the fluorescent matter in the unexcited state, $Nh\nu$ the excitation energy per gm. mol, $I_{Fe^{2+}}$ = ionisation energy of ferro-ion, X = alteration of potential energy of reaction partners during the electron transfer. J. E.

2141. Theories of Phosphorescence. M. Curie. *Comptes Rendus*, 202. *pp.* 751–753, *March* 2, 1936.—Comments on Muto's recent theory of phosphorescence based on Wilson's semiconductor model [see Abstracts 1593 and 1594 (1936)]. (1) Fluorescence alone does not go with external photoelectric effect. The latter is shown only with phosphorescence of long duration. (2) the *d* bands (excitation of phosphorescence) do not depend on the nature of the impurity. On the contrary they are approximately the same for the same diluent. (3) In the author's opinion it is the phosphorescent centre (round the impurity) that is important—not the diluent lattice. (4) the metastable states, being of such long duration sometimes, require a very special explanation. (5) The excitation action of infra-red requires explanation. J. E.

2142. Luminescence of Fluorites and other Minerals. Part II. H. Haberlandt. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 9–10. *pp.* 663–666, 1935.—Further studies on the spectra, particularly at low temperatures, confirm the close relation between the fluorescence, the rare-earth content and the genesis of the mineral. The thermoluminescent spectra also indicate the geochemical conditions of genesis. [For Part I see Abstract 2968 (1935).] J. E.

2143. Reactions between Sodium Vapour and Volatile Polyhalides. Velocities and Luminescences. W. Heller and M. Polanyi. *Faraday Soc., Trans.* 32. *pp.* 633–642, *April*, 1936. The reaction velocities of a series of polyhalides (BCl_3, BBr_3, CCl_4, $SiCl_4$, $SiBr_4$, $GeCl_4$, $SnCl_4$, $TiCl_4$, PCl_3, $AsCl_3$, SCl_2, S_2Cl_2, $COCl_2$, $POCl_3$, CrO_2Cl_2) reacting with sodium vapour are determined by the "diffusion method." Owing to the extreme rapidity of most of the reactions the rates of a few only can be quantitatively determined, while the order of magnitude and the sequence of reactivity are established for the rest. The polyhalides of the elements belonging to the middle groups of the periodic table show the highest inertia in reacting with Na-vapour. In a homologous series the chemical inertia increases with the restoring force acting in the halogen

linkage. Na-vapour reacts with CS_2-vapour; probably by a three-body collision. 13 different new luminescences are observed arising from the reactions of Na-vapour with BCl_3, BBr_3, $SiBr_4$, $GeCl_4$, PCl_3, SCl_2, S_2Cl_2, $COCl_2$, $POCl_3$, CrO_2Cl_2 and from a mixture of Na-vapour and O_2 reacting with CS_2, SCl_2 and S_2Cl_2. AUTHORS.

See also Abstract 2446.

INTERFERENCE. DIFFRACTION AND SCATTERING.

2144. Diffraction of Light by Thin Wires. B. Eichstädt. *Zeits. f. Physik*, 99. 5–6. *pp.* 301–340, 1936.—It is shown experimentally that the positions of the maxima and minima of Fresnel diffraction patterns under ordinary conditions are excellently predicted by the Fresnel-Kirchhoff theory, or by the Sommerfeld or Ignatowski formulæ. Experiments on diffraction by very thin silvered quartz fibres in polarised light show that the fringes can be displaced according to the direction of the polarisation. The displacements can be explained with the help of work by Raman and Krishnan. It is found that a phase difference of π between the two components of the light diffracted by such threads, as predicted by Pfenninger, does not exist. C. B. A.

2145. Diffraction Problem. J. Delsarte. *Comptes Rendus*, 202. *pp.* 826–828, *March* 9, *and pp.* 1026–1028, *March* 23, 1936.—The simple problem of diffraction of spherical waves at an unlimited plane is treated mathematically, and it is shown that it can be solved completely. C. B. A.

2146. Diffraction at a Metal Screen with a Straight Edge. J. Savornin. *Comptes Rendus*, 202. *pp.* 935–937, *March* 16, 1936.—The Sommerfeld and Poincaré treatments of diffraction at a straight metal edge do not give results which are in accordance with experiment, since in white incident light the diffracted light is coloured, and its tint depends on the metal forming the screen. This effect is explained qualitatively by a treatment due to Raman and Krishnan, which is now developed and applied to screens made of steel, gold and copper. C. B. A.

2147. Longitudinal Light Scattering. M. Katalinić. *Kolloid Zeits.* 74. *pp.* 288–296, *March*, 1936.—A critical review is given of the work which has so far been published upon the so-called Plotnikow effect [see Abstract 4204 (1935)]. Plotnikow's explanation of the effect as due to a deviation of the primary light beam by large molecular complexes is considered to have no foundation. Attention is drawn to the fact that attempts to confirm the existence of the effect have failed when optically purified liquids have been used. Experiments by the author on vacuum-distilled water are quoted as evidence in this connection. By applying Stokes' law it is found possible to explain as due to suspended dust particles some of the regularities of the Plotnikow effect. L. A. W.

See also Abstracts, 2091, 2154, 2194, 2309, 2310, 2311.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2148. Radiation Emitted in Dehydration and Hydration of Quinine Sulphate. R. Audubert and M. Prost. *Comptes Rendus*, 202. *pp.* 1047–1049, *March* 23, 1936.—The radiation emitted by a layer of quinine sulphate spread on a disc and heated (or cooled) is measured by a CuI photo-electric counter, which is sensitive to radiation of $\lambda\lambda$ 2000–2500 [see Abstract 2072 (1935)], placed at a distance therefrom of 2 cm. The

emission accompanying hydration is 6–8 times as great as that accompanying dehydration. It is independent of the thickness of the layer of $< 2 \cdot 5$ gm./cm^2. The energy of the radiation thus emitted is only 10^{-13} to 10^{-14} of that corresponding to the heat of hydration. C. A. S.

2149. Photochemical Decomposition of Oxalyl Chloride Vapour. K. B. Krauskopf and G. K. Rollefson. *Am. Chem. Soc., J.* 58. *pp.* 443–448, *March*, 1936.—Oxalyl chloride decomposes slowly when illuminated with light of any wave-length below 3800 Å. The reaction is predominantly unimolecular, and has a low quantum yield. The final products of decomposition are $COCl_2$ and CO, but various lines of evidence indicate that the initial products are Cl_2 and CO. Most of the experimental observations can be explained satisfactorily by assuming that oxalyl chloride decomposes by two different mechanisms. When illuminated with light of short wave-length the molecule breaks at the C–C bond; with light of longer wave-length a break at one of the C-Cl bonds predominates. The absorption coefficients of oxalyl chloride are measured between 3700 and 2400 Å. Authors.

2150. Photolysis of Lead Tetramethyl and Lead Tetraphenyl. P. A. Leighton and R. A. Mortensen. *Am. Chem. Soc., J.* 58. *pp.* 448–454, *March*, 1936.—Continuous u.v. absorption producing decomposition into metallic lead and hydrocarbons is observed for lead tetramethyl and tetraphenyl. The method of radioactive indicators is applied to determine quantum yields for lead tetramethyl vapour and for both compounds in solution, and to show the formation of methyl radicals during the photolysis of lead tetramethyl vapour. Short chains, retarded by oxygen, are indicated in the vapour; deactivation or recombination reduces the quantum yield in solutions. Authors.

2151. Mercury-Photosensitised Decomposition of Arsine. N. L. Simmons and A. O. Beckman. *Am. Chem. Soc., J.* 58. *pp.* 454–459, *March*, 1936.—The Hg photosensitised decomposition of AsH_3 corresponds to the stoichiometric equation $AsH_3 = As + 3/2\ H_2$. About 5 % of the H_2 disappears during the reaction, presumably by clean-up on the walls of the reaction cell. An As film forms on the cell window during the decomposition. The rate of decomposition is directly proportional to the intensity of the radiation and is independent of the arsine pressure at high pressures. At low pressures the rate is decreased on account of the fluorescence of activated Hg atoms. The decomposition is very slightly inhibited by H_2. Recombination of As and H_2 occurs with the formation of arsine, but the rate is negligibly slow in comparison with the rate of decomposition of arsine. The quantum yield for the decomposition is $1 \cdot 03 \pm 0 \cdot 05$ molecules of arsine decomposed per quantum of 2537 Å radiation absorbed. A mechanism for the decomposition is proposed. Authors.

2152. Photochemistry of Nitrites, Nitrates, and Nitro Compounds. H. W. Thompson and C. H. Purkis. *Faraday Soc., Trans.* 32. *pp.* 674–680, *April*, 1936.—As a preliminary to photochemical work, the u.v. absorption spectra of methyl and ethyl nitrites, methyl and ethyl nitrates, and nitro-methane and ethane in the vapour state are measured. All except the nitrites show continuous absorption. The nitrites each have a system of diffuse bands in the near u.v. The bands are not all of equal intensity, and some have a peculiar variation of intensity within themselves. A marked vibration interval in the excited state seems to be about 1000 cm.$^{-1}$. There appear in general to be two excited electronic

levels, both probably involving excitation of electrons localised in the N = O chromophore. The significance of the results is discussed. The vapour pressures of the various compounds over a wide range of temperature are measured. AUTHORS.

2153. Photo-Oxidation of Methylene Iodide. R. A. Gregory and D. W. G. Style. *Faraday Soc., Trans.* 32. *pp.* 724–736, *April*, 1936. —The products of the photo-oxidation of methylene iodide are studied and a mechanism accounting quantitatively for the products is proposed. The intermediate formation of CH_2, CH_2O_2 and $(CH_2O)_2$ is assumed. The minimum value of the activation energy of the reaction of methylene with oxygen is 1920 Cal. The peroxidic substances CH_2O_2 and $(CH_2O)_2$ change over spontaneously into formic acid and formaldehyde respectively. AUTHORS.

2154. New Sensitometry of Photographic Layers. A. Narath. *Zeits. f. techn. Physik*, 17. 3. *pp.* 70–80, 1936.—Gives details of a new method of obtaining sensitometric measurements of photographic emulsions which requires the production of light graduations by means of interference of two polarised light rays. It is necessary to obtain distinctive lines which exhibit unequivocal intensity functions and possess definite wave-length relationships. After briefly discussing the basic principles of the method, the theory of photochromatic distinctive lines is developed, dealing with monochromatic and polychromatic lines. The production of photochromatic distinctive lines is then considered in detail, practical examples of the usefulness of the method finally being given. [See Abstract 695 (1935).] R. C. F.

2155. Sensitising Dyes and their Applications to Scientific Photography. C. E. K. Mees. *Roy. Inst., Proc.* 29. 1. *pp.* 136–149, 1936. *Nature*, 137. *pp.* 726–730, *May* 2, 1936.—Deals first with the development of sensitising dyes of the cyanine group, the latest types being the carbocyanines obtained from the thiazole bases. These are far better sensitisers than the dyes derived from quinoline, and by making use of them new panchromatic emulsions have been prepared which are generally known as "super" or "hyper-sensitive" emulsions. They have, however, made no appreciable changes in astronomic or spectrographic photography, the second part of the paper thus dealing with the development of infra-red sensitisers. Up to 1904 the limit of the photographic spectrum was 6000 Å, this being extended by the discovery of pinacyanol to beyond 7000 Å. Dicyanine, a difficult dye to use, extended it to beyond 8000 Å, but it was only easy to reach this wave-length after the discovery of kryptocyanine in 1919. The production of neocyanine in 1925 extended the range to 9000 Å, xenocyanine, first obtained in 1932, enabled 11,000 Å to be reached, and the new penta-carbocyanine has now extended the photographic spectrum to beyond 12,000 Å. R. C. F.

2156. Effect of Temperature on Sensitivity. M. Roulleau. *Comptes Rendus*, 202. *pp.* 835–837, *March* 9, 1936.—Deals briefly with the results of an examination of the effects of temperature on the sensitivity of commercial plates suitable for aerial photography, the types examined being ordinary, orthochromatic and panchromatic plates, and emulsions sensitised for the infra-red. The results obtained show that there is a decrease in sensitivity with decrease in temperature from 20° C. to −60° C., two emulsions—an orthochromatic and a panchromatic emulsion—showing maxima at −20° C. R. C. F.

2157. Bichromate Gelatins. Part I. E. Elöd and H. Berczeli. *Kolloid Zeits.* 74. *pp.* 305–315, *March,* 1936.—For the quantitative investigation of gelatins with respect to their suitability for development purposes in chromate photography, special methods of testing are required. For finding the behaviour of the unexposed gelatin, the rate of dissolution is selected and a method based upon this property is now described in which the influence of sensitisation and the location of the sensitised film can be measured. To test the behaviour of the sensitised and exposed gelatin film, the evaluation of its apparent sensitivity to light is investigated. For quantitative purposes the thickness of the tanned layer in the dry state is taken. The influence of the concentration and composition of the bichromate compounds upon the apparent light sensitivity is then evaluated and the most favourable working conditions established. These various determinations afford a quantitative characterisation of commercial gelatins with respect to their availability for chromate photography.

H. H. Ho.

2158. Photographic Emulsions. C. S. Lialikov and V. N. Piskunova. *Acta Physicochimica,* 4. 2. *pp.* 325–340, 1936. *In English.*—A simple method is worked out for determining the solubility of AgBr during emulsion formation. It is determined at various temperatures and in various concentrations of KBr both in the absence and the presence of NH_3. The data obtained are compared with the values yielded by the gravimetric method and with the results of other authors. It is shown that on increasing the concentration of KBr, the solubility of AgBr in the presence of NH_3 at first rapidly decreases, then remains almost constant and finally, with high concentrations of KBr, again increases. It is shown that gelatin does not strongly affect the solubility of AgBr but that KNO_3 increases it, especially at low concentrations of KBr. Authors.

2159. Evolution of the Photographic Latent Image. C. Jausseran. *Ann. de Physique,* 5. *pp.* 355–426, *March,* 1936.—The evolution of the latent image is of great importance when considering the theoretical aspect of photography or its photometric applications. After considering the complexity of photographic examinations and giving details of the methods used, the results obtained on the evolution of the latent image for the Jougla plate are given. These show that the modifications which occur in the latent image between exposure and development result in the density of the developed image increasing as the logarithm of the age of the impression or exposure. The increase observed depends on the illumination of the plate and is a maximum with normal exposure. Its value is considerably affected by the nature of the developer and the development time, metol producing large variations whereas hydroquinone has hardly any effect. This increase is attributable to a specific property of the latent image in gelatin AgBr, although there are certain emulsions illustrating the reverse phenomena. The influence of the exposure and the state of the emulsion, action of various aqueous solutions after exposure, study of different emulsions, comparison of the two types of evolution and the influence of the age of the latent image on the properties of the developed image are other points discussed. It is concluded that neither the latent image nor the developed image can be defined by the value of the density of this latter image. R. C. F.

***2160. Aerial Photography. B. B. Talley.** *Mechanical Engineering,* 58. *pp.* 151–156, *March,* 1936.—Discusses the technique of obtaining good aerial photographs, dealing with the necessary cooperation between

pilot and photographer, the type of camera to be used and films available, exposure time, lens and shutter speeds, filters and development time.

R. C. F.

See also Abstracts 2061, 2161, 2313, 2411.

PHOTOMETRY.

2161. Extreme Ultra-Violet Photographic Photometry. Renée Montagne and R. Ricard. *Comptes Rendus*, 202. *pp.* 477–479, *Feb.* 10, 1936.—The authors investigate the density-exposure relation for plates sensitised for u.v. with sodium salicylate. The constant γ^1 (illumination constant, exposure time varied) is found to have the same value to about 10 % for radiations of wave-length 2000 to 1280 Å. The difficulties and advantages in the use of plates sensitised with fluorescent substances for u.v. photometry are discussed. W. S. S.

***2162. Heterochromatic Ultra-Violet Photometry. E. J. Bowen.** *Roy. Soc., Proc.* 154*A*. *pp.* 349–353, *April* 1, 1936.—A quartz cell, 1 cm. in thickness, containing aesculin solution, 1 gm./l. in water, placed before a potassium photoelectric cell, can be used as a relative quantum counter for the wave-length region 3665–2500 Å with a sensitivity many times that of a thermopile-galvanometer combination. The use of some other fluorescent substances is investigated. Author.

***2163. Photoelectric Photometer. L. E. Howlett.** *Canad. J. of Research*, 14. *Sect.A. pp.* 38–42, *Feb.*, 1936.—A description is given of a photoelectric photometer for measuring general light transmission through glasses, solutions, etc. It is suitable for grading where light transmission is the control. It has been successfully used to measure precisely, quickly and conveniently such quantities as the amounts of dyes removed from solutions by porous bodies, and the concentrations and purities of substances in solution. Author.

***2164. Photoelectric Measurement of the Absorption of Sodium Resonance Radiation. F. Fairbrother and J. L. Tuck.** *Faraday Soc., Trans.* 32. *pp.* 624–633, *April*, 1936.—A sensitive photoelectric photometer is developed for the measurement of the intensity of a beam of sodium resonance light, with a precision of $\pm$ 0·1 %. For this purpose a stable, balanced d.c. amplifier (which may also be used as a valve electrometer) is constructed, using an Osram T113 electrometer valve. The technique of making electrical resistances of very high value, by evaporating gold on to glass rods, is briefly described. Some photoelectric measurements of the absorption of sodium resonance light are given, extending down almost to the melting-point of sodium. It is found that I_t/I_o (intensity of transmitted light/intensity of incident light) approximates very closely to a linear function of the number of sodium atoms in the path of the light, up to about 45 % absorption of the light. It is also found that Beer's law is obeyed in this absorption, over a much smaller range. Author.

2165. Interpolation of the Standard Visibility Function with One Millimicron Steps. Z. Yamauti and M. Okamatu. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 388. [22 *pp.*], 1935. *English Abstract.*—In this interpolation the logarithms of the standard values of the visibility function (taken as correct) are subjected to third difference osculatory interpolation. The values of $\log V_\lambda$ obtained in this way and the derived values of V_λ are tabulated together with Judd's interpolated values of V_λ. The extended function obtained from the logarithmic

interpolation is found to be smoother than Judd's extended function based on direct interpolation. W. S. S.

See also Abstracts 2103, 2254, 2445.

POLARISATION.

2166. Polarisation of Molecular Diffusion Spectrum of Liquid CCl_4. A. Rousset. *Comptes Rendus*, 202. *pp.* 654–656, *Feb.* 24, 1936.—Spectrographic measurements of the depolarisation of monochromatic light scattered from liquid CCl_4 are made (a) with a wide slit to include the whole wave-length band of the scattered radiation (b) with a narrow slit to include only the radiation unchanged in wave-length (c) with a plate immediately behind the slit of the spectrograph. The values obtained lead to the conclusion that there is an optical anisotropy of the CCl_4 molecule; also that the Raman band corresponding to the symmetrical oscillation ($\Delta\nu = 459$ cm^{-1}) is not completely polarised, and that the degenerate frequencies ($\Delta\nu = 219$ and 316 cm^{-1}) are not completely depolarised. **Errata,** *ibid. p.* 884, *March* 9, 1936. D. H. F.

2167. Two Properties of Sources of Polarised Light. Y. le Grand. *Comptes Rendus*, 202. *pp.* 939–941, *March* 16, 1936.—It is shown that (i) for bright sources whose apparent dia. does not exceed a few degrees, it is possible with the naked eye to recognise whether the source is emitting polarised light and to indicate the orientation of the plane of polarisation; and that (ii) with a source emitting partially-polarised light, by use of a doubly-refracting plate and an optically-active plate in series, it is possible to obtain an intensity on the retina greater than that observed with the naked eye. C. B. A.

See also Abstracts 1922, 2207, 2209, 2236.

RADIATION, EMISSION.

2168. Structure of Cosmic Radiation. R. Hilgert and W. Bothe. *Zeits. f. Physik*, 99. 5–6. *pp.* 353–362, 1936.—A number of observations of quadruple coincidences were made with various dispositions of lead sheets, and it is concluded that the coincidence-producing particles arising in the Pb are not part of a group originating from a single point but are produced in different parts of the Pb by a radiation consisting of bundles of particles. D. H. F.

2169. Photographs of Cosmic Ray Tracks Obtained at the International Laboratory on the Jungfraujoch (3450 m.). P. Ehrenfest, Jr. and P. Auger. *J. de Physique et le Radium.* 7. *pp.* 65–66, *Feb.*, 1936.—Using an apparatus consisting of an expansion chamber, a counter, a block of lead, a second counter, a second expansion chamber and a third counter mounted in order one above the other, the cosmic rays causing simultaneous firing of the ensemble are examined on the Jungfraujoch (3450 m.). Reproduced photographs show (1) the relative number of showers in the lower chamber corresponding to solitaries in the upper chamber is much higher when the lead is 2 cm. thick than when it is 15 cm. thick; (2) the rays which traverse 15 cm. of lead produce many fewer secondaries of high energy than those produced by component tracks of a shower; (3) a considerable number of very soft secondaries is produced even by particles of high penetrating power: (4) showers containing thousands of tracks occur with sufficient frequency to explain the Hoffmann "bursts". F. C. C.

2170. Disintegrations by Cosmic Rays. J. Solomon. *J. de Physique et le Radium*, 7. *pp.* 71–76, *Feb.*, 1936.—Disintegrations, with emission of heavy particles (protons, neutrons, or α-particles), due to the passage of high-energy electrons through matter are investigated generally on the basis of relativistic quantum mechanics and by a semi-classical method. The probability of such processes is found in all cases to be extremely low, and of the order of that of the production of pairs by an electron. It is concluded that if high-velocity protons are found at ground level they are probably primary in origin and not due to disintegrations by high-energy electrons. N. M. B.

2171. Cloud-Chamber Photographs of Counter-Selected Cosmic-Ray Showers. E. C. Stevenson and J. C. Street. *Phys. Rev.* 49. *pp.* 425–428, *March* 15, 1936.—A detailed discussion is given of the appearance of cosmic-ray showers from a lead plate 1·3 cm. thick in a large cloud chamber controlled by three G–M counters, one above and two below the chamber. Showers of photons were responsible for about half the triple coincident counts, but sprays of electrons from the lead accounted for the tripping of the lower counters in most of the other cases. Three-quarters of the single-centred electron shower sprays were due to electrons which traversed the upper counter and struck the lead from above. The remainder were due to non-ionising rays, presumably photons. 23 photographs out of a total of 174 showed complex phenomena. The distributions of the showers according to size and the shower electrons according to angular spread are given. Authors.

2172. Variations of Properties of Cosmic Shower Radiations with Altitude. J. C. Stearns. *Phys. Rev.* 49. *pp.* 473–474, *March* 15, 1936.—Using an irregular triangular formation of three counters the author shows that the shape of the coincidence-frequency/Pb-thickness curve is independent of altitude between 120ft. and 14000 ft. above sea level. and has a maximum at about 1·6 cm. of Pb. With three counters placed one above the other the coincidence counting rate was observed when a sheet of Pb was placed above the top counter and when it was placed above the bottom counter. The difference was plotted against Pb thickness, and the shape of this curve also was found to be independent of altitude, the maximum being at 1cm. of Pb. Data on the absorption of shower particles at different levels were also obtained. D. H. F.

2173. Contribution of Cosmic Radiation to the Ionisation of the Upper Atmosphere and Earth-Magnetic Analysis of Primary Cosmic Radiation. T. H. Johnson. *Am. Geophys. Union, Trans. Part.* 1. 1935. *Frank. Inst., J.* 221. *pp.* 417–429, *March*, 1936.—Evidence is marshalled to show that the contribution of cosmic rays to the conductivity of the upper atmosphere is negligible compared with that arising from other sources. Forty small counters are connected in parallel groups of three each, arranged on the periphery of a cylindrical chassis, and pulses from diametrically opposite groups are combined with those from a central group of five counters for the selection and recording of coincidences. The instrument thus combines in one unit, seven coincidence trains each pointing in a different direction. Studies of asymmetry of the radiation at various latitudes and altitudes lead to the conclusions that (*a*) the shower-producing primaries consist of equal numbers of positive and negative electrons, (*b*) the positive asymmetric part of the primary radiation is probably protons. For latitudes 0°, 29° and 50° the variations of asymmetry with zenith angle and elevation are given approximately by absorption

coefficients for the magnetically deviable rays of 0·33, 0·36 and 0·53/m of water respectively. It is an anomalous fact that these absorption coefficients vary less than would be expected for rays the energies of which are 15, 10 and 3×10^9 V. F. C. C.

2174. Diurnal Variation of Cosmic Radiation. V. F. Hess and H. T. Graziadei. *Terr. Mag.* 41. *pp.* 9–14, *March,* 1936.—A final account is given of a series of observations of the cosmic-ray ionisation on the Hafelekar (2300 m. above sea-level) covering three years (1932, 1933, and 1934) with about 20,000 hourly values obtained with Steinke's standard apparatus at constant temperature. The existence of a regular diurnal variation of the cosmic-ray ionisation according to local time (Middle European Time) is proved. Its amplitude amounts to $\pm$ 0·2 % of the total ionisation; the maximum occurs at noon, the minimum between 21^h and 3^h M. E. T. A discussion of the possible causes of this variation is given. It must be ascribed to an indirect or direct solar influence upon the intensity of the cosmic-ray ionisation. AUTHOR.

2175. Cosmic Radiations and Astronomical Research. L. Gilchrist. *Roy. Astron. Soc. Canada, J.* 30. *pp.* 65–83, *March,* 1936.—Excepting meteorites, information about extra-terrestrial bodies is derived from the properties and effects of the radiations they emit when correlated with those from laboratory sources. The author classifies them as oscillatory (infra-red to ultra-violet) and very penetrating, giving examples of researches in 1935:—on the existence of an element nebulium; the remarkable binary ζ Aurigae; on Nova Herculis; the identification of phosphorus in the sun; the spectrum of the corona out of eclipse; solar magnetism; atmospheric condition on the planets; and on cosmic rays. He traces the history of the α, β, and γ radiations and the separation of the last from true cosmic rays; the theory of them as waves or photons; the finding of their variation with latitude and longitude; of their deflection by the earth's magnetic field; of the indication from Geiger counters that they are charged corpuscles and very largely positrons, even at the earth's surface. A. S. D. M.

2176. Absorption of Cosmic Rays in the Milky Way. F. Zwicky. *Nat. Acad. Sci., Proc.* 22. *pp.* 182–186, *March,* 1936.—If cosmic rays are of extra-galactic origin, absorption by the gas and dust clouds in the Milky Way region might produce directional asymmetry. The amount of absorption may indicate the amount of matter in the form of particles under 10–100 cm. diameter. Present estimates suggest an absorption of 3 %. This might be detected with Geiger counters. This effect, along with deflections caused by the earth's magnetic field, is capable of yielding an analysis of the constituents of cosmic rays. T. L. M.

2177. Energy of Cosmic Rays. P. M. S. Blackett and R. B. Brode. *Roy. Soc., Proc.* 154*A*. *pp.* 564–587, *May* 1, 1936.—Cloud-chamber observations were made using an electromagnet which gives a field of 14,000 gauss in a gap of 15 cm. between pole-pieces 25 cm. in dia. for a power of 25 kW. The cloud chamber was 27 cm. in dia. and 3 cm. deep. Corrections for optical distortion in the photographing of the tracks, and for distortion of the tracks themselves by air currents in the chamber, are discussed at length. 188 vertical rays are recorded, energy measurements having significance up to 2×10^{10} V. The number of positives and the negatives is about the same, except that the particles with energy greater than 10^{10} V seem to be mainly positive. It is shown that over the energy

range 2×10^9 to 2×10^{10} V the number of particles having an energy E is proportional to $1/E^2$. D. H. F.

2178. Emission of Ultra-Violet Radiation in the Reboul Effect. O. Viktorin. *Comptes Rendus*, 202. *pp.* 941–943, *March* 16, 1936.—Examination of the radiation emitted in the Reboul effect with photo-cells sensitive to the ultra-violet shows that u.v. wave-lengths between 2600 and 2000 Å, whose intensity depends on the voltage, are emitted at the positive face of the pellets. The quantity of electricity passing in a given time decreases with time, and no relationship is found between current intensity and intensity of the radiation. C. B. A.

See also Abstract 2337.

RADIATION, GENERAL THEORY.

2179. Electronic Nature of Light. J. L. Destouches. *Comptes Rendus*, 202. *pp.* 921–923, *March* 16, 1936.—The author shows that a system formed by an electron and a positron, the masses of which are assumed to be of electromagnetic origin, has certain states which can be assimilated with the photon. On introducing the coordinates of the centre of gravity into the relativistic wave equation of the system it is shown that there is no separation of the relative motion and the motion of the centre of gravity ; separation takes place only if the centre of gravity is at rest or undergoing slow motion, or if the relative motion vanishes. A consideration of these cases leads to the result that the wave equation of the system has solutions such that the relative motion around the centre of gravity vanishes, these corresponding to the neutralisation of the charges or the disappearance of the mass, and satisfy the de Broglie wave equation of the photon. A photon would thus have zero rest-mass and would consist of an electron and positron in states such that the relative motion around the centre of gravity vanishes. This conclusion would supplant the neutrino theory and eliminate the assumption of hypothetical particles. N. M. B.

2180. Equation of the Photon. J. J. Placinteanu. *J. de Physique et le Radium*, 7. *pp.* 127–132, *March*, 1936.—Regarding a photon as a complex particle formed by the association of an electron and a positron, the coupling involving the presence of a material nucleus, an equation, invariant for a Lorentz transformation, is formulated for the photon. Spin distribution, and the conditions for the disappearance of the de Broglie longitudinal wave, are established. The probability density corresponds with that predicted by Dirac ; the continuity equation and the expressions for the probability current are found. Results, in general agree with the theory of de Broglie [see Abstract 279 (1935)], some of the difficulties of which are overcome. N. M. B.

REFLECTION. REFRACTION AND DISPERSION.

***2181. Effect of a Cover Glass in Reflectance Measurements. D. B. Judd and K. S. Gibson.** *Bureau of Standards, J. of Research*, 16. *pp.* 261–264, *March*, 1936.—It has been found from theoretical considerations that the use of a cover glass may result in an error of as much as 10 % when two diffusing surfaces, one light and one dark, are compared for apparent reflectance. The error arises from multiple reflections between sample and cover glass, the lighter sample obtaining much more added illumination from this cause than the darker. The error depends on the angular distribution of the illuminant, the angle of view, and the diffusing characteristics of the samples as well as their reflectances. AUTHORS.

***2182. Gloss Investigations. R. S. Hunter.** *J.O.S.A.* 26. *pp.* 190–196, *April,* 1936. *Bureau of Standards, J. of Research,* 16. *pp.* 359–366, *April,* 1936.—A target pattern of concentric rings varying from fine lines to broad bands is placed in the open face of a desk lamp. This luminous target is useful in the study of the gloss characteristics of the more glossy surfaces. The lines and bands of various sizes in the target provide means for studying surfaces of a wide range of " distinctness-of-reflected-image " gloss. Records may be made of which lines and bands are visible by reflection from different surfaces. Such records serve as permanent gloss values for the different surfaces studied. The dark areas of the target immediately adjacent to the luminous areas provide ideal conditions for the identification of surface " bloom." The best gloss differentiations are made when the lamp is used in a darkened room so that the luminous pattern is the only source of light illuminating the surfaces inspected. Photographic records of gloss and unusual gloss effects are discussed. AUTHOR.

***2183. Optics : Edited by T. Smith. Part I. Theory of Optical Instruments. T. Smith. Part II. Teaching of Elementary Optics. T. Smith. Part III. Vision. J. Guild. Part IV. Colorimetry. J. Guild.** *Phys. Soc., Reports,* 2. *pp.* 356–371, 1935.

2184. Approximations to the Cartesian Oval. H. S. Uhler. *J.O.S.A.* 26. *pp.* 128–131, *March,* 1936.—Corrections are made to certain equations put forward by Silberstein [see Abstract 4572 (1935)], and it is pointed out that it is possible to obtain the desired algebraic expressions in more compact and practical form. **L. Silberstein,** *ibid., p.* 131, also corrects certain mistakes in the original paper. A. H.

2185. Qualitative Investigation of Spherical Aberration in Optical Systems. J. van Zuylen. *Physica,* 3. *pp.* 243–254, *April,* 1936. *In German.*—A simple and rapid qualitative method for investigating spherical aberration in optical systems is described. It consists essentially in focusing a rectangular grating, with the diaphragms in the positions which are to be investigated. The type of deformation of the image indicates the correction necessary. Coma-free systems are investigated in detail, and applications of the method are described. C. B. A.

2186. Refractive Index Changes in Optical Glass Occasioned by Chilling and Tempering. F. Twyman and F. Simeon. *J.O.S.A.* 26. *p.* 121, *March,* 1936.—Points out in reference to a recent paper by Hopfield and Watkins [see Abstract 672 (1936)], that the effect in optical glasses was studied some years ago. In the case of dense barium crown glass a lowering of refractive index of 0·004 was found. The original index was restored by heating to the annealing temperature for 2 hr., while 90 hr. at a temperature 70° C. lower failed to restore it. F. S.

2187. Simplified Calculation of Structural Double Refraction. A. Papapetrou. *Zeits. f. Krist.* 94. *pp.* 80–85, *April,* 1936.—A method of deducing the optical anisotropy of a crystal lattice is given depending on the anisotropic arrangement of the lattice cells, themselves assumed to be isotropically polarisable, similar *inter se,* and forming a simple elementary translation lattice. The case only is considered in which λ is large compared to cell dimensions, and the lattice cubic or approximately so. C. A. S.

2188. Variation of Double Refraction in Celluloid with Amount of Permanent Stretch. F. C. Harris and B. R. Seth. *Phys. Soc., Proc.* 48. *pp.* 477–486 ; *Disc.,* 487, *May* 1, 1936.—Different specimens of celluloid (xylonite) are stretched beyond the elastic limit, so that they have produced in them amounts of permanent stretch which differ from one

specimen to another. The residual double refraction at constant temperature is measured in each specimen at a number of wave-lengths in the visible spectrum, and the dispersion in every case is found to follow the law $n/\lambda^2 = A - B\lambda$, where n is the permanent double refraction in wave-lengths at the wave-length λ and A and B are constants for the particular specimen. It is found also that in each specimen n has a maximum value at some wave-length λ_M, the values of λ_M being less in those specimens which have smaller permanent stretches than in those which have larger permanent stretches. Observations are made on the effect produced on the dispersion and on the values of λ_M by increase of temperature.

AUTHORS.

2189. Dispersion of Crystalline and Fused Quartz. J. Engl. *Ann. d. Physik*, 25. 7. *pp.* 600–608, *April*, 1936.—For the refractive dispersion of quartz in the visible and u.v. regions a two-term formula is proposed: $R = (n^2 - 1)/(n^2 + 2) = A/(a-x) + B/(b-x)$ where $x = c^2/\lambda^2$, c being the velocity of light *in vacuo*. The most trustworthy measurements of the refractive indices, from Sosman's "Properties of Silica," for crystalline quartz (ordinary and extraordinary rays) and fused quartz are satisfactorily represented over the range $\lambda\lambda$ 1850–5400, the greatest deviations being $\pm 7 \times 10^{-5}$ for crystalline and $\pm 20 \times 10^{-5}$ for fused quartz. For $\lambda\lambda > 5000$ the deviations increase rapidly with λ in each case. The data and deviations are tabulated. The least-squares values of the constants A, B, a, b are given, and the transition probabilities corresponding to the resonance frequencies of the formula are evaluated. The results are fully discussed in relation to the dispersion and absorption data for CO_2 and O_2. W. J.

2190. Optical Constants of Metals. H. M. O'Bryan. *J.O.S.A.* 26. *pp.* 122–127, *March*, 1936.—The refractive indices, the reflecting powers at normal incidence and the extinction coefficients are obtained by a method similar to that used by Brewster. The metals are evaporated *in vacuo*, on to thin glass plates, which can be rotated *in situ* and waves from a special mercury arc, after separation by a monochromator, are passed through a nicol, reflected by the metal turned to the angle to give maximum polarisation and caused to return along the same path by normal reflection from a second surface. Now the angles of incidence and azimuth are measured (these are in agreement with earlier results by Minor for Ag) and by Kettler's equation the various factors determined. From these results the dielectric constants and the atomic rates of absorption are deduced, tabulated and shown as graphs against wave-lengths as ordinates. Discussions on absorption and atomic state follow, and it is seen that metals with two, three or four valence electrons have much higher atomic rates of absorption and that it is among these that supraconducting elements occur. H. M. B.

2191. Optical Properties of Ketone-Alcohol Mixtures. T. Tomonari. *Zeits. f. phys. Chem.* 32. *Abt.B.* 3. *pp.* 202–221, 1936.—Measurements of refractive indices and densities of mixtures of alcohols and ketones in presence of acid are used to demonstrate the formation of alcohol-ketones complexes under the influence of hydrogen ions. In ketone-alcohol mixtures the formation of the complex is encouraged by acid, whereas in acetone-water mixtures (in which a complex readily forms in the absence of acid) addition of acid does not affect the equilibrium. Effects due to shielding of the polar CO or OH groups are observed. C. B. A.

***2192. Figuring and Correcting of Mirrors by Controlled Deposition of Aluminium. J. Strong and E. Gaviola.** *J.O.S.A* 26. *pp.* 153–162, *April*, 1936.—It is possible to change the figure of reflecting surfaces quantitatively by controlled deposition of metals, evaporated *in vacuo*. The theory for calculating screens and the experimental technique are described. A spherical 12-inch mirror has been repeatedly parabolised, obtaining a surface perfect within 0·05 wave-length. A $\frac{5}{8}$-inch spherical mirror has been parabolised with the optical axis outside of its periphery. A defective parabolic mirror was corrected for turned up and down edges. A convex spherical secondary mirror was hyperbolised. The limitations and possible applications of the method are discussed. [See following Abstract.] AUTHOR.

***2193. Quantitative Use of the Foucault Knife-Edge Test. E. Gaviola.** *J.O.S.A.* 26. *pp.* 163–169, *April*, 1936.—The work described in the foregoing paper [see preceding Abstract] made necessary the development of a quantitative method of surveying surfaces that could be used for local measurements and on non-symmetric surfaces. The theory of the method and the experimental technique are described. The accuracy of the survey is better than 1/20 wave-length with visual subjective observation and could be carried up to 1/100 wave-length with objective photographic measurements. The errors of the Foucault knife-edge test, especially the one produced by parallax, are discussed. Ways of reducing or eliminating them are described. AUTHOR.

***2194. Resolving Power of the Microscope Measured with Grayson's Rulings. P. H. van Cittert.** *K. Akad. Amsterdam, Proc.* 39. 2. *pp.* 182–190, 1936.—The theory of the resolving power with and without a condenser is investigated. The case is taken of the illumination of an object with wide-opened beams, *i.e.*, completely non-coherent, for simplification of the calculations and it is compared with that of parallel, or completely coherent, illumination. Curves illustrate the visibility of the observed images against the line distance for different widths of the transparent slits and the visibility decreases as b approaches Δ. Thus with parallel light Grayson's test plate gives a resolving power that nearly agrees with the theoretical value $2\Delta A/\lambda = 2$. With a condenser it is impossible to measure the double resolving power, but a resolving power determined not only by the aperture of the objective but also by the nature of the object measured. To compare the resolving power of a microscope with the theoretical value the use of parallel illumination is advisable. R. S. R.

See also Abstract 1943, 1944, 2033, 2034, 2060.

SPECTROSCOPY.

***2195. Spectroscopy: Edited by H. Dingle. Part I. Determination of Wave-Length Standards. C. V. Jackson. Part II. Isotope Effects in Spectra of Diatomic Hydrides. R. W. B. Pearse. Part III. Astronomical Spectroscopy. A. Hunter. Part IV. Infra-Red Band Spectra of Organic Molecules. L. Kellner. Part V. Hyperfine Structure of Spectrum Lines and Nuclear Moments. E. G. Jones.** *Phys. Soc., Reports*, 2. *pp.* 329–355, 1935.

2196. Extreme Ultra-Violet Wave-Length Identification Lists. J. C. Boyce and H. A. Robinson. *J.O.S.A.* 26. *pp.* 133–143, *April*, 1936.—Wave-length lists are presented to facilitate identification of lines in the extreme ultra-violet. These lists are based on published results

from this and other laboratories and on some unpublished results from this laboratory. One table contains lines likely to be present in gas discharges, another gives the lines arising from the more common constituents of glass, and a third lists the principal line or group of lines of each of the first five spectra of a number of elements, where such line or group of lines is to be found in the extreme ultra-violet. While every effort has been made to select lines on a self-consistent scale of wave-lengths, it is emphasised that these lines should not be used indiscriminately as standards of wave-length.

AUTHORS.

2197. First Spark Spectrum of Copper. A. G. Shenstone. *Roy. Soc. Phil. Trans.* 235*A*. *pp.* 195–243, *March* 12, 1936.—The spectrum of the copper kathode Schuler tube has been photographed with long exposures from 10,000 to 600 Å. From the 1350 lines the analysis has identified the following structures: $3d^9 4s$, $5s$, $6s$, $7s$, $8s$; $3d^9 4p$, $5p$, $6p$; $3d^{10}$; $3d^9 4d$, $5d$, $6d$, $7d$; $3d^9 4f$, $5f$, $6f$; $3d^9 5g$; $3d^8 4s^2$; $3d^8 4s 4p$. There are over forty series of three or more levels. The structures $d^9 f$ and $d^9 g$ are completely identified for the first time. The most striking feature is the number of levels which show the effects of mixed configurations. Perturbations in position and combining properties are common, including cases of $\Delta S = 2$ and of $\Delta l_1 = 2$ $\Delta l_2 = 3$. The values of many high levels can be found accurately from cross combinations in the visible and near ultra-violet. Their combinations with low levels then form an excellent system of calculated wave-lengths down to $\lambda 675$, which can be used as accurate standards in that region. A. C. M.

2198. Absorption Spectrum of Phenanthrene and Spectrum of Anthracene at 20° Abs. I. W. Obreimov and A. Prikhotjko. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 34–56, 1936. *In English.*—The absorption spectrum of phenanthrene in polarised light consists of three regions; the first, of frequency 26,000–28,000 cm^{-1}., consists of a few lines or narrow weak bands; the second, 28,000–33,000 cm^{-1}., is the main spectrum; the third, beyond 33,000 cm^{-1}., consists of broad diffuse bands. The spectrum for the light vector parallel to the (010) plane consists of bands which are a little narrower than in the spectrum of the other component. These constitute the narrow and broad spectra. Photographs, measurements, intensities and data for these two spectra in each of the three regions, with thick and thin crystals, are given and discussed. The spectrum of anthracene is similarly described, the two spectra in polarised light showing a general resemblance. The absorption bands are so broad and numerous that they overlap and give the impression of five very broad bands. With polarised light, these bands show a different width according to the orientation of the polarisation. The spectrum of gaseous anthracene is very similar to that of the crystal, being a superposition of both crystalline spectra, the broad and the narrow. Results are discussed in relation to crystalline structure. N. M. B.

2199. Spectrum of Trebly Ionised Thorium. R. J. Lang. *Canad. J. of Research*, 14. *Sect. A. pp.* 43–47, *Feb.*, 1936.—An analysis of the spectrum of Th IV is given which includes practically all the stronger known line of Th which can be attributed to the trebly ionised atom. This spectrum all lies on the short wave-length side of 2350 Å, with the exception of one line, 7S—7P, which falls at 2694·00 Å. Most of the lines of the spectrum above 2000 Å are quite intense in the spark in air, but do not appear at all in the arc and are definitely enhanced in the vacuum spark. The separation of the deepest 7P terms has the relatively enormous value of

12818 cm^{-1}. The terms 7P, 6D, 7D, 8D, 7S, 8S, 9S, 5F and 5G have been found. The ionisation potential of Th^{+++} is approximately 29·4 V.
AUTHOR.

2200. Extreme Ultra-Violet Spectra of Zinc and Cadmium. L. Bloch and E. Bloch. *Ann. de Physique*, 5. *pp* 325–354, *March*, 1936.—An oscillating electrodeless discharge through the metallic vapours is investigated with vacuum grating (1m.) spectrographs, at normal incidence for the higher $\lambda\lambda$ and at grazing incidence with greater dispersion for lower $\lambda\lambda$, penetration of the vapours into the spectrographs being prevented by liquid-air cooling. Long lists of new measures are given, which join the previous results of Esclangon and the authors at the long-λ end, and extend to λ227·36 for Zn and λ212·06 for Cd. Previous measures as far as λ677 for both metals are collected for comparison, except those of Takahashi whose assignments to ZnII are very doubtful. From spectrograms with increasing excitations fairly complete assignments of lines to ZnII, ZnIII, ZnIV and CdII, CdIII, CdIV are made over a wide range, and probable classifications of the fundamental multiplets of ZnIV and CdIV are proposed. W. J.

2201. Series Limit Continua and Line Intensities in the Helium Spectrum. H. O. Jancke. *Zeits. f. Physik*, 99. 3–4. *pp*. 169–188, 1936. —Intensities of lines and continuous spectra are measured in the emission from plasma of d.c. and a.c. He discharges. The electron energies in the plasma are determined from probe measurements. Significant differences are noticed between the intensities of the continua emitted by d.c. and a.c. and between singlet and triplet spectra. It is concluded that besides the elementary recombination process proposed by Bohr there are also processes taking part in production of the limiting continua in which highly excited neutral atoms interact with electrons. J. E. K.

2202. Reversal of Neon Lines 744 and 736 Å. T. Takamine and T. Suga. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 602. *pp.* 1–7. *Feb.*, 1936. *In English.*—When a strong condensed discharge is passed through a long Ne tube filled at several mm. pressure, the resonance lines 744 and 736 Å come out very much broadened. Of the two lines, the line λ 736 is much more conspicuously reversed than the line λ 744, with a white gap in the core extending to about 0·3 Å. The contour of the line λ 736 is quite asymmetric, with its wing extending toward the shorter wave-length side, and resembles very much that of the He resonance line 584 Å. Referring to the work of Weizel [see Abstract 4194 (1931)] on the broadening of the He line λ 584, it is mentioned that the existence of certain unstable electronic levels of the Ne molecule might be presumed. AUTHORS.

2203. Reversal Temperature and Population of Excited States in the Caesium Discharge. F. L. Mohler. *Bureau of Standards, J. of Research*, 16. *pp*. 227–231, *March*, 1936.—Light from a W strip-lamp is projected through the positive column of a Cs discharge on to the slit of a spectrograph, and the lamp temperatures determined at which the Cs lines disappear against the continuous background. Measurements are made on the lines 6S–6P to 6S–11P at different pressures and discharge currents. The reversal temperature decreases from the first to the third line and beyond the third there is no measurable difference. It increases with increasing current and with decreasing pressure. The number of atoms in an excited state is given by an equation of the form of the Boltzman equation, with the reversal temperature replacing the equilibrium tempera-

ture. The number per c.c. ranges in magnitude from 10^{12} for the first P state to 10^6 for the highest states. In the range of conditions studied it is independent of pressure at constant current. AUTHOR.

2204. Magnetic Moment of $^6_3$Li. H. Schüler and T. Schmidt. *Zeits. f. Physik*, 99. 3–4. *pp.* 285–286, 1936.—On the assumption of a mechanical moment $i = 1$, the magnetic moment of $^6_3$Li is calculated from hyperfine structure measurements to be $\mu = +0{\cdot}6 \pm 0{\cdot}2$ nuclear magneton. J. E. K.

2205. Hyperfine Structure of Platinum Isotopes. Part I. B. Jaeckel and H. Kopfermann. *Zeits. f. Physik*, 99. 7–8. *pp.* 492–502, 1936.—The hyperfine structures of 46 Pt. I lines are photographed and analysed in the region from 5900 Å to 2350 Å with a Fabry-Perot etalon. The analysis shows that there are four comparatively abundant Pt isotopes, Pt. 194, Pt. 195, Pt. 196 and Pt. 198 having relative abundances of 10 : 9 : 7 : 2. It is found that the mechanical nuclear moment of Pt. 195 is $I = \frac{1}{2}$. From the positions of the isotope displacements in the lines the isotope term displacements are determined. The maximum displacements occur in $5d^86s^2$ terms and amount to $0{\cdot}2$ cm^{-1}. The positions of the centres of gravity are such that in each multiplet term Pt. 194 has the largest ionisation potential. J. E. K.

2206. Isotope Shift in the Resonance Line of Magnesium. D. A. Jackson and H. Kuhn. *Roy. Soc., Proc.* 154*A*. *pp.* 679–683, *May* 1, 1936.—The singlet resonance line, 2852 Å of Mg is found by the atomic beam method to possess two components separated by $0{\cdot}033 \pm 0{\cdot}002$ cm^{-1}. The component of greater wave-length is very much stronger than the other. The splitting of the line is ascribed to an isotope shift, the stronger line being due to the most abundant isotope 24, and one of the other isotopes, 25 and 26, and the weak components due to the third isotope ; it is also possible that the strong component is due to 24 alone and the weak component due to the other two, but the relative intensities of the two components make this improbable. [See Abstract 1140 (1935).] AUTHORS.

2207. Polarisation of Light Emitted by an Atom, Excited in Stages. P. Soleillet. *J. de Physique et le Radium*, 7. *pp.* 118–126, *March*, 1936.—Calculations are made of the state of polarisation of the light emitted by an atom (which has been excited optically in two steps) in terms of the polarisations of the two exciting radiations. If the atom is in a zero magnetic field, there are eleven constants, which can be calculated from the transition probabilities. An application of the theory is made to the case of emission in stages. A. C. M.

2208. Perturbations of NeI Terms. Y. Ishida and T. Tamura. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 623. *pp.* 9–18, *March*, 1936. *In English.*—The spectral series of NeI converge to two distinct groups of limits, except for a limited number of sequences. These irregularities are here accounted for as having their origin in perturbations, but the identification of the perturbing terms has not been possible. A. H.

2209. Applications of the Theory of Coherence of Vibrations. P. Soleillet. *Comptes Rendus*, 202. *pp.* 1167–1168, *March* 30, 1936.—Recent experiments by Kastler confirm his calculations of the polarisation of Hg $\lambda\lambda$ 4046, 4358, 5461 excited by Hg $\lambda\lambda$2537 and by Hg λ 4358 ; in the cases studied the two exciting vibrations have a common axis of symmetry, and the calculations involve the composition of entirely incoherent elementary vibrations. Kastler is also studying experimentally the case

of excitation by radiations plane-polarised at right angles to one another, in which no common symmetry exists. For the even Hg isotopes (*i.e.* no hyperfine structure) Weisskopf shows that a symmetry of the resultant with respect to an axis perpendicular to the two exciting vibrations should lead to the former cases. The general calculation for all the isotopes can be carried out if coherence of the elementary vibrations is assumed [see Abstract 202 (1936)]. Results of calculations for broad-line excitation of $\lambda\lambda$ 4046, 4358, 5461 are given for (i) even isotopes only and (ii) for both odd and even isotopes; they agree with Kastler's experimental results. The theoretical curve of depolarisation as a function of a magnetic field in the direction of observation can also be obtained; this, too, agrees with Kastler's observations. W. J.

2210. Spectrum of Selenium in the Red and Infra-Red Regions. B. Rosen and F. Monfort. *Physica*, 3. *pp.* 257–265, *April*, 1936. *In French.*—The band spectra of Se_2 are excited in a h.f. electrodeless discharge. The fluting bands on the long wave-length side of the main $^1\Sigma—^1\Sigma$ system are investigated in some detail. These bands correspond to transitions between a quasi-stable electronic level situated at about 25,000 cm^{-1}. ($\omega' \simeq 50$ cm^{-1}.) and the high excited vibrational levels of the normal state ($\omega'' = 391$ cm^{-1}.). The great difference between the frequencies of the two states explains the characteristic structure of this system. A new band system is observed; it can be represented by the following formula: $\nu = 16{,}706 + 270\,v' - 2{\cdot}5\,v'^2 - 325\,v'' + v''^2$; the excited level in the same as that of the main system. The heat of dissociation of Se_2 is discussed. The value 1·9 V given previously by Rosen and Désirant seems to be the only one, agreeing with spectroscopic data. AUTHORS.

2211. Vibration Rotation Spectrum of Acetylene in the Photographic Infra-Red. G. W. Funke. *Zeits. f. Physik*, 99. 5–6, *pp.* 341–352, 1936.—Nine new bands in this region are found and analysed. Certain bands, formerly incompletely investigated, are completely examined. The band at 9645 Å has a Q branch indicating that the levels in the upper states are split in a way similar to the splitting in diatomic molecules. An exposure at −80° C. is also discussed. A graphical method is employed to calculate B values. W. R. A.

2212. New Band of NO. M. Duffieux and L. Grillet. *Comptes Rendus*, 202. *pp.* 937–939, *March* 16, 1936.—A band at about 6000 Å previously observed in the spectrum of a discharge through NO_2 is now examined under higher dispersion (6·6 Å per mm.) It is symmetrical and consists of P- and R-branches, in each of which the first thirty terms are distinct. Each term is a triplet whose components are nearly equal in intensity, and the frequency of the central component is given by $\nu = 16{,}669{\cdot}75 + 3{\cdot}913m - 0{\cdot}00807\,m^2$, m varying from −1 to −30 for the P-branch and from + 1 to +30 in the R-branch. Indications of an embryonic Q-branch are observed. The band is attributed to the ionised NO molecule, since it appears immediately in the spectrum of this gas. The moment of inertia deduced is $14{\cdot}6 \times 10^{-40}$, which is that to be expected from the C $^2\Sigma$ state of NO, but the band is not to be attributed to this state, since the $^2\Sigma$ bands should be doublets. The triplet structure is not in accordance with neutral NO molecules, but is compatible with NO^+. C. B. A.

2213. Fine Structure of the Absorption Band of Water Vapour at 0·94μ. J. H. Hsu. *Chinese Journ. Phys.* 1. *pp.* 59–67, *Oct.*, 1935. *In English.*—The absorption band of water vapour at 0·94μ is studied

photographically by means of a concave grating spectrometer. 28 component lines are observed and measured on a comparator as well as on a Moll microphotometer. This band shows something of a doublet form which suggests that the H_2O molecule has a triangular form with the O atom at the vertex of an obtuse angle. The lines agree closely with some of the absorption lines in the solar spectrum as measured by Abney in 1880. AUTHOR.

2214. Infra-Red Absorption Spectra of Chlorine Derivatives of Methane. C. Corin. *Comptes Rendus*, 202. *pp.* 747–749, *March* 2, 1936.—In continuation of previous work on liquid methane [see Abstract 1205 (1936)] the infra-red absorption spectra below 3μ of its Cl derivatives (liquid) are now studied, 15 bands being recorded for CH_3Cl and for CH_2Cl_2, and 18 for $CHCl_3$. CCl_4 gives no band in this region. Nearly all the bands can be classified as harmonics and combinations of the fundamental frequencies of methane and of the derivatives. Substitution of NO_2 for H in $CHCl_3$ completely alters the spectrum, 7 new bands, characteristic of $C(NO_2)_4$ being observed. A parallelism is observed between the number of CH bonds in the molecule and the intensities of the bands. C. B. A.

***2215. Near Infra-Red Absorption Spectra of Alcohols as a Function of the Temperature, up to and beyond the Critical Point. A. Naherniac.** *Comptes Rendus*, 202. *pp.* 649–651, *Feb.* 24, 1936.—Using an apparatus capable of withstanding temperatures of 500° C. and 1000 kg./cm^2. pressure and so constructed that the liquid or vapour could be examined by merely turning the tube, spectra of methyl, ethyl, propyl, isopropyl, and isobutyl alcohols are examined up to $1{\cdot}0\mu$. The intensities and positions of the bands at different temperatures and pressures are discussed. W. R. A.

2216. Infra-Red Absorption Spectra of Mixtures of Alcohol and Water. D. Williams, R. D. Weatherford and E. K. Plyler. *J.O.S.A.* 26. *pp.* 149–152, *April*, 1936.—The absorption spectra of absolute ethyl alcohol and alcohol containing water are studied in the region from $1{\cdot}5\mu$ to 5μ. In the water-alcohol mixtures there appears a band at $2{\cdot}8\mu$ not characteristic of either alcohol or water. For small concentrations of water the intensity of this band is found to increase with increasing water content. The presence of the band at $2{\cdot}8\mu$ is interpreted as indication of association between the water and alcohol molecules. This result is in agreement with the anomalous changes in volume and in specific heat which take place in mixtures of alcohol and water. AUTHORS.

2217. Dissociation of SnCl and $SnCl_2$. H. Lessheim and R. Samuel. *Indian Journ. Phys.* 10. *pp.* 7–12, *Jan.*, 1936.—A reply to criticisms of Trivedi [see Abstract 3513 (1935)] on an earlier paper by the authors [see Abstract 4928 (1933)]. W. R. A.

2218. Far Ultra-Violet Absorption Spectra of HCl and Several Chlorides. R. Tréhin. *Ann. de Physique*, 5. *pp.* 445–607, *April*, 1936.—For a study of the constitution of strong electrolytes, the u.v. absorption in HCl from λ 2816 to λ 1990 and in NH_4Cl, LiCl, NaCl, KCl, $MgCl_2$, $CaCl_2$, $SrCl_2$, $BaCl_2$ from λ 2500 to λ 2170 is measured by photographic photometry, with the H_2 continuum, a small quartz spectrograph and a recording microphotometer. The substances are carefully purified by methods fully described. For aqueous solutions of HCl and the chlorides the observations are so planned and so numerous that the effects of temperature and concentration at each λ are separated. The variations of absorption and

of extinction coefficient with change of each of the four variables, wave-length, temperature, concentration, and atomic number of kation are studied. Measures are also made for solutions of HCl in ether, for liquid HCl at –90° C., for solutions of NaCl in glycerine, and for rock-salt. The observational data and results are shown in 22 tables and 33 diagrams, and the conclusions are discussed theoretically. W. J.

2219. Absorption of Light by Porphyrins. Part V. A. Stern and H. Wenderlein. *Zeits. f. phys. Chem.* 176. *Abt.A.* 2. *pp.* 81–124, 1936.—Continuing previous work [see Abstract 1679 (1936)] the absorption spectra of porphyrin derivatives are investigated in the range 480 to 670 $m\mu$. A further mass of data is accumulated upon the effects of the presence of various substituents upon the position and intensity of the absorption bands and the results are discussed in relation to the structures of the molecules investigated. It is found, *inter alia*, that the effects of mono- and di-oxime formation in derivatives with two carbonyl groups are in harmony with previous conclusions as to the structure of the normal porphyrins. Introduction of Mg into the dihydroporphin system greatly intensifies the band in the red. Observations of the influence of the C = N grouping in various porphin and dihydroporphin oximes, as well as in the di-iminoporphyrins, allow of deductions as to the structure of the chlorins, *i.e.* the dihydroporphin system. The structure of an anhydride of rhodoporphyrin-γ-carboxylic acid is confirmed by the evidence of the absorption spectrum. Also a synthetic chlorin is found to possess an absorption spectrum identical with that of natural dihydro-phyllochlorin, so that it is concluded that both must have the same ring system. L. A. W.

2220. Ultra-Violet Spectra of the Bromine Derivatives of Aniline. Marie É. P. Rumpf and P. Rumpf. *Comptes Rendus*, 202. *pp.* 1063–1065, *March* 23, 1936.—The spectral region between the visible and 2750 Å is studied for aniline and its bromo-derivatives by means of a Hilger spectrograph and a Lambert and Chalonge microphotometer. In the case of aniline dissolved in hexane the series of narrow bands already described by Klingstedt was found but in alcohol there is only one large band (maximum at 2845 Å). The substitution of Br displaces the absorption maximum towards the long wave-lengths in a regular but not additive manner. The differences observed for aniline in hexane and alcohol hold also for the bromoanilines. The influence of Cl appears to be approximately equal to that of Br in the same position, but a nitro-group displaces the maximum further towards the long wave-lengths. H. H. Ho.

2221. Behaviour of the 4930Å Absorption Band of Uranine Solutions Under High Pressure. W. J. Lyons. *J.O.S.A.* 26. *pp.* 144–145, *April*, 1936.—The object of this investigation is to test experimentally the assumption of electromagnetic dispersion theory that the natural period of vibration of the resonators of a medium remains constant with variations in pressure. Two dilute aqueous solutions of uranine of slightly different concentrations is studied in the high-pressure spectrometer. Refractive indices for the three principal lines of the mercury arc, and for the wave-length corresponding to the absorption band maximum (4390Å) are determined for pressures ranging up to 915 kg. per cm.^{2} in one solution, and up to 1823 kg. per cm.^{2} in the other. It is found that the absorption band retains its position relative to the rest of the spectrum formed by the liquid prism under various pressures. It is concluded that the natural frequency of vibration of the resonators is affected to no measurable extent by the pressure or density of a medium. AUTHOR.

2222. Absorption Spectra of Symmetrical Cyanine Dyes. Nellie I. Fisher and Frances M. Hamer. *Roy. Soc., Proc.* 154*A*. *pp.* 703–723, *May* 1, 1936.—Eleven sets of symmetrical cyanine dyes have been prepared, of which each set differs from the other ten in the nature of the heterocyclic nuclei. In general, each set comprises four members which differ from one another in the method of linking of the nuclei ; this is either by one : CH., or by a chain composed of three, five, or seven such groups. 39 of the 44 compounds aimed at have been prepared, some of them for the first time, and absorption spectra of their methyl-alcoholic solutions have been examined under standard conditions. The frequencies of maximum absorption have been calculated, and correlated with changes in chemical constitution. Data concerning fluorescence are recorded.

AUTHORS.

2223. Absorption Spectra of Aromatic Compounds. Parts I and II. P. K. Seshan. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 148–187, *Feb.*, 1936.—In Part I several aromatic hydrocarbons are studied for their absorption spectra in the vapour state over the spectral range 7000 Å to 2200 Å . A general analysis is made of the band systems, and the values of vibrational frequencies of the molecules in the normal and in the excited states, and of the electronic frequencies of the molecules, are calculated therefrom. These frequencies are discussed in relation to the structure of the molecules, and in relation to their physical states of aggregation. In Part II the absorption spectra of some quinones and hydroquinones in the vapour state are studied from 7000 to 2200 Å, with a high dispersion spectrograph. Many of them show a vibrational structure, and some of them also a rotational fine structure. The bands for the simplest of the molecules, namely benzoquinone and hydroquinone, are analysed, and the characteristic vibrational frequencies of the normal and excited molecules are determined. For the other molecules the vibrational frequencies for the excited state only could be so obtained. The substances are studied also in solution. The rotational and vibrational structures observed with the vapours are all quenched, and the maxima of absorption are considerably shifted towards the red end of the spectrum. In the solid state, in which also two of the substances are studied, there is a further shift of the absorption-maxima in the same direction. AUTHOR.

2224. Dissociation Products of CN and the 6·9-Volt Dissociation Energy of CO. R. Schmid. *Zeits. f. Physik*, 99. 7–8. *pp.* 562–568, 1936.—The band-spectroscopic value, 6·9 V, of the dissociation energy of CO leads to the conclusion that the experimental value, 177 k.cal, of the heat of sublimation of solid carbon represents the process $C_{solid} \rightarrow C\ (^5S)$ [see Abstract 1664 (1936)]. From this result the dissociation energy of CN $(x^2\Sigma) \rightarrow C(^5S) + N\ (^4S)$ is estimated as 8·15 V. The calculated position of the combined energy level of $C\ (^3P) + N(^2P)$, the dissociation products of each of the CN excited states $A^2\Pi$ and $B^2\Sigma$, agrees well with the extrapolated position of the $B^2\Sigma$ convergence level. The break-off of the vibrational levels in the three electronic states is attributed to the energy levels of $C\ (^3P) + N(^4S)$ and $C\ (^3P) + N\ (^2D)$. On the basis of this conclusion the electron-collision process $C_2N_2 \rightarrow C^+ + N + CN$ observed at 22·5 V is satisfactorily interpreted. W. J.

2225. Intensities in Bands of Violet Cyanogen System. N. R. Tawde. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 140–147, *Feb.*, 1936.—Quantitative estimation of vibrational intensities in $^2\Sigma \rightarrow {}^2\Sigma$ system of CN is made by the method of heterochromatic spectrophotometry. The results

are used to examine some aspects of Condon's theory and effective temperature derived on the assumption of the thermal distribution of molecules in vibrational levels. Some features of intensities in sequences are discussed. AUTHOR.

2226. Hindered Rotation in Liquid H_2O and D_2O. C. H. Cartwright. *Phys. Rev.* 49. *pp.* 470–471, *March* 15, 1936.—The concept of a quasi-crystalline structure for liquids does not exclude the possibility of free or hindered rotation which depends on the intermolecular field of potential energy. Assuming a tetrahedral quartz-like structure for the H_2O molecule, the calculated intermolecular field leads to the prediction of a characteristic frequency at 60 μ, and a frequency at 20 μ due to hindered rotation. The existence of these bands and the predictions of their variations in H_2O and D_2O are confirmed by observations of the infra-red absorption, reflection, and dispersion. The observed characteristics and shifts of these bands and a theoretical explanation are described and discussed. N. M. B.

2227. Frequencies of Vibration of Organic Chlorine Derivatives. Deduced from Infra-Red and Raman Spectra. H. C. Cheng and J. Lecomte. *Ann. de Physique*, 5. *pp.* 427–441, *March*, 1936.—Infra-red absorption spectra from 7 to 15μ have been obtained and are used to explain certain Raman frequencies. The origin of various frequencies in mono- di- and tri-chloro-derivatives is suggested. W. R. A.

2228. Vibrations of Tetrahedral Pentatomic Molecules. Jenny E. Rosenthal. *Phys. Rev.* 49. *pp.* 535–537, *April* 1, 1936.—The requirement that the forces along the bonds of the YX_4 molecule be fairly large as compared with " interaction forces " is shown to be sufficient to remove the ambiguity in the values of the constants in the potential energy function ; no further special assumptions as to the types of forces involved are necessary. The ratio of the masses of the Y and X atoms determines in practically every case which set of force constants is the chemically acceptable one. Limiting values are given for the constant of the YX bond for CH_4, CCl_4, $TiCl_4$, $SO_4^=$, and other molecules. Wherever possible comparison is made between the limiting and the actual values. [See Abstract 5062 (1934).] AUTHOR.

2229. Continuous Spectra. Part I. G. Joos and W. Finkelnburg. *Die Physik*, 4. 1. *pp.* 35–46, 1936.—A review of investigations of the known classes of continua, *viz.*, true continua including those associated with electron collison processes, ionisation limits, molecular dissociation, etc., and statistical continua including those due to the overlying of broadened and unresolved lines, and those whose intensity distribution is affected by circumstances causing absorption and re-emission, etc. Numerous references are given to original papers and comprehensive reports which appeared up to the middle of 1935. W. J.

2230. Fluorescence of Sodium Salicylate. G. Déjardin and L. Herman. *Comptes Rendus*, 202, *pp.* 651–654, *Feb.* 24, 1936.—A fairly weak band between 2400 and 2800 Å with maxima at 2500 and 2700 Å is reported. There is some indication of another band in the region of 3300 Å. W. R. A.

2231. Influence of Physical State on Absorption and Fluorescence Spectra of Organic Substances. P. K. Seshan. *Faraday Soc., Trans.* 32. *pp.* 689–694, *April*, 1936.—The absorption and fluorescence spectra of certain aromatic compounds are investigated with the compounds in different physical states—vapour, liquid, solid and solutions in

different solvents. Passing from the vapour to the solutions, and thence to the liquid and solid states there is observed (1) a progressive broadening of the absorption bands, (2) a progressive shift of the band system as a whole towards the red, the relative dispositions of the components remaining practically unaltered. Examination shows that the greater the refractive index of the medium in which the absorbing molecules are dispersed, the greater is the shift, towards the red, of the absorption bands of the molecules, from their positions in the vapour state. The influence of the physical state on fluorescence is very similar to that on absorption. A. H.

2232. Deformation Frequencies in the Raman Spectra of Linear Molecules: Acetylene. S. Bhagavantam and A. V. Rao. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 135–139, *Feb.*, 1936.—Two new bands at $\Delta\nu$ 589 and 646 are recorded in the Raman spectrum of acetylene gas by giving a long exposure. These are interpreted as the maxima of the unresolved *O*, *P*, *R* and *S* branches of the total symmetric deformation vibration of C_2H_2. The negligible intensity of the *Q* branch and the observed separation of about 57 wave numbers between the bands are in accordance with such an interpretation. The frequency shift of about 615 corresponding to the mean position of the bands is in good agreement with the value deduced from the infra-red absorption for the frequency of this oscillation.

AUTHORS.

2233. Raman Effect in Ammonia. P. Daure, A. Kastler and H. Berry. *Comptes Rendus*, 202. *pp.* 569–572, *Feb.* 17, 1936.—Raman spectra of gaseous, liquefied, and dissolved NH_3 are given; and the state of polarisation of the lines. For the gas one strong, polarised frequency is obtained; pure rotation lines, alternately strong and weak are observed, but no vibration-rotation lines. For liquefied and dissolved NH_3 the spectra are similar and consist of three lines, the central one corresponding with the frequency given by the gas. One of the outer lines is polarised and the other is depolarised. In liquid NH_3 and in solutions in acetone and alcohol the intensities of the wings are comparable with the intensity of the central frequency; but in aqueous solutions the intensities of the wings are diminished. This variation in intensities is discussed.

W. R. A.

2234. Raman Spectrum of Acid Titanic Chloride. Marie É. P. Rumpf. *Comptes Rendus*, 202. *pp.* 950–952, *March* 16, 1936.—The Raman spectra of $TiCl_4$ and of its solutions in concentrated HCl are investigated. From the fact that three new lines appear in the spectra of the solutions it is concluded that these arise from the presence of the compound $TiCl_4.2HCl$, or H_2TiCl_6. W. R. A.

2235. Quantitative Analysis of Mixtures of Nitric and Sulphuric Acids by means of the Raman Effect. J. Chédin. *Comptes Rendus*, 202. *pp.* 1067–1069, *March* 23, 1936.—A range of mixtures of HNO_3 and H_2SO_4 containing from 5 to 100 per cent of HNO_3 is investigated. In each case the Raman spectrum of the mixture is taken together with that of a mixture containing 10 per cent of HNO_3 for comparison and the blackening curve of the plate is also recorded by means of suitable intensity marks. The sulphuric acid has a dehydrating effect on the nitric acid, producing N_2O_5 which gives a sharp intense Raman line at $\Delta\nu = 1398$ cm.$^{-1}$. The relative intensity of this line is taken as a measure of the relative concentration of N_2O_5. As it is found that the nitric acid is completely dehydrated in the 10 per cent solution taken as comparison, the observations give

directly the percentage by weight of N_2O_5 in the mixtures of higher HNO_3 content, due account being taken of differences of density. L. A. W.

2236. Polarisation of Raman Radiation and Molecular Constitution. B. Trumpy. *Zeits. f. Physik*, 98. 11–12. *pp.* 672–683, 1936.—Raman frequencies and their depolarisation factors are given for trimethylcarbinol, and tetrabromethane; also frequencies of tetrachlorodeuterethane, isomeric mixture of *cis* and *trans* dichlorodeuterethylene, and the individual isomers. The molecular structures are discussed and trimethylcarbinol is found to have C_3v symmetry. The isotopic shifts in the deuterium compounds are discussed. W. R. A.

2237. Raman Effect in Organic Compounds of Sulphur. P. Donzelot and M. Chaix. *Comptes Rendus*, 202. *pp.* 851–852, *March* 9, 1936.—The Raman spectra are given for diphenylene oxide, diphenylene sulphide, and diethyl mono-, di- and tri-sulphides. To the —C—S group are attributed the frequencies 635, 655, 960, 1045 and 1150 cm.$^{-1}$, and to —S—S frequencies in the neighbourhood of 180 and 500. A. C. M.

2238. Raman Spectra of Organic Borates. M. S. Joglekar and V. N. Thatte. *Zeits. f. Physik*, 98. 11–12, *pp.* 692–701, 1936.—The spectra of methyl, ethyl, butyl, amyl, *iso*-amyl, and phenyl borates exhibit certain frequencies attributable to BO_3. As a possible explanation it is assumed that these arise from the similarity between the BO_3 ion and the $B(OR)_3$ molecule. W. R. A.

2239. Raman Effect of Cyclopentyl Derivatives. K. W. F. Kohlrausch, A. W. Reitz and W. Stockmair. *Zeits. f. phys. Chem.* 32. *Abt.B.* 3. *pp.* 229–236, 1936.—The Raman spectra of some mono-substituted derivatives of cyclopentane (C_5H_9X with X = OH, NH_2, CH_3, SH, Cl, Br and I) and of cyclopentanone are determined. Substitution is found to have a typically different effect upon the spectrum from that observed in the case of the corresponding derivatives of cyclohexane [see Abstract 1712 (1936)]. This is considered to be connected with the difference in the angles between the plane of the ring and the C–X bond in the two cases. It is noted that mono-substitution, especially by a halogen, causes a greater increase in the number of frequencies for cyclohexane than for cyclopentane. The suggestion is made that this may indicate that the mono-derivatives of cyclohexane exist in two forms. L. A. W.

2240. Slightly Modified Scattered Radiation of Crystals and the Characteristic Vibrations of the Molecules of the Lattice. M. Vuks. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 2. *pp.* 72–76, 1936. *In German.*—Raman spectra are photographed and measured for the two crystalline modifications of *p*-dichlorbenzene and for crystalline *p*-dibrombenzene. All the spectra contain lines of relatively small frequency shifts. These lines, which are not observed for organic liquids, are ascribed to mutual vibrations of the molecules in the crystal lattice. The spectra of the two modifications differ as regards these small frequency shifts (the α-modification has $\Delta\nu = 27{\cdot}5$, $46{\cdot}5$, $54{\cdot}0$ and 93 cm.$^{-1}$, while the β-modification has $\Delta\nu = 43{\cdot}3$, $54{\cdot}5$ and $82{\cdot}0$ cm.$^{-1}$), although the greater frequencies are identical. Different small frequency shifts ($\Delta\nu = 20{\cdot}1$, $37{\cdot}8$ and 93 cm.$^{-1}$) are also observed for the *p*-dibrom-compound. L. A. W.

2241. New Type of Spectrum in the Scattering of Light by Crystals, and the Structure of Liquids. E. Gross and M. Vuks. *J. de Physique et le Radium*, 7. *pp.* 113–117, *March*, 1936.—New lines are

found in the spectra of the light scattered by single crystals of diphenyl-ether, benzene, naphthalene and para-dibromo-benzene. These lines are in the region from 20 cm.$^{-1}$ to 130 cm.$^{-1}$. The authors conclude that the continuous spectrum near to the Rayleigh lines scattered by the substance when in the liquid state is due to vibrations in the lattice in the main, rather than to the rotational Raman spectrum. A. C. M.

***2242. Registration of Infra-Red Spectra. S. Fahrentholz.** *Zeits. f. techn. Physik*, 17. 3. *pp.* 67–68, 1936.—This paper describes an improvement in the method of recording due to Reinkober [see Abstract 133 (1930)]. The wave-length setting of the spectrometer is automatically shifted in steps, and for each setting the galvanometer readings corresponding to the following automatically produced sequence of conditions are recorded photographically as dots: (*a*) radiation from the source passing directly into the spectrometer slit, (*b*) radiation cut off, (*c*) radiation passing through the specimen before reaching the slit. Errors due to variations of the light source are thus eliminated. [See following Abstract.] D. H. F.

***2243. Evaluation of Infra-Red Absorption Records. S. Fahrentholz.** *Zeits. f. techn. Physik*, 17·3. *pp.* 68–69, 1936.—This paper describes a simple apparatus which enables the ratio of two lengths to be obtained directly, without the necessity of measuring them. Its use shortens considerably the evaluation of records such as those obtained by the recording infra-red spectrometer described elsewhere [see preceding Abstract]. D. H. F.

***2244. Monochromator for the Near Ultra-Violet. F. Benford.** *J.O.S.A.* 26. *pp.* 99–104, *March*, 1936.—Fused quartz is employed to permit of the construction of a very powerful instrument in which the maximum amount of monochromatic energy is aimed at, spectral purity and wave-length accuracy being considered of secondary importance. The monochromator being of single type the striæ and bubbles in the fused quartz produce much stray radiation; this is overcome by changing slightly the angles of the Pellin-Broca prism and thus refracting the unwanted radiation out of the back of the prism. The instrument should be valuable in biological work in view of the large amounts of energy that may be transmitted. A. H.

***2245. Rotating Sector for Quantitative Analytical Spectrography. M. F. Hasler and R. W. Lindhurst.** *Rev. Sci. Instruments*, 7. *pp.* 137–139, *March*, 1936.—A new sector arrangement is devised for use with a grating spectrograph in quantitative spectrography. Difficulties encountered with the logarithmic sector—that measurements necessitate a base line, that the scale is crowded, that the sector is not in the same plane as the slit—are obviated by using a half-cylindrical shutter in front of the film. The axis of rotation is the axis of the cylinder. The shutter is so mounted that the axis is parallel to the plane of the film, and perpendicular to the slit. The shutter weakens the middle of the line, causing the line to split into two. The distance between the two extremities is measured and the intensity ratios are obtainable with an accuracy of 5 per cent. A. H.

2246. Spectra of Metals Encountering Explosion Waves. H. Muraour and A. Michel-Lévy. *Comptes Rendus*, 202, *pp.* 949–950, *March* 16, 1936.—Finely divided metals are introduced into the environmental gas and the spectrum so obtained is discussed. W. R. A.

*2247. **Explosive Spark and Intermittent Arc and their Use in Quantitative Spectrum Analysis. T. Kosbahn.** *Ann. d. Physik*, 25. 7. *pp.* 625–644, *April*, 1936.—The illumination of the slit is considered and the homogeneous method advocated. A special stand for both spark and intermittent arc is described and the electrical circuits given, that for the spark being the one used by Sawyer and Becker [see Abstract 1577 (1923)]. Stress is laid upon the reproducibility of each light source, and spectroscopic investigation made of the influence of various excitation conditions. F. S.

2248. Spectrographic Study of the Surface of Duralumin Alloy. H. Triché. *Comptes Rendus*, 202. *pp.* 745–747, *March* 2, 1936.—The mechanism of the formation of films of oxide on electrodes made of Al alloys during electrolysis is investigated by means of a spectrographic examination of an electrode from point to point on its surface [see Abstract 720 (1936)]. The clean surface of a duralumin electrode gives lines of equal intensity from Mg, Al and Cu, with others from Si and Ca. After electrolysis with chromic acid as electrolyte, the intensity of the Cu lines is much diminished as compared with those of Al and Mg, whilst those of Si and Ca disappear. With H_2SO_4, all the lines are affected alike. Slight treatment with chromic acid followed by H_2SO_4 gives results similar to the electrolysis with H_2SO_4 alone; but with longer pre-treatment with chromic acid, electrolysis in H_2SO_4 quickly gives a uniform white deposit, and the spectrum of this is the same as that obtained after treatment with chromic acid alone. It is concluded that the oxide film only forms after Cu, Si and Ca have been selectively eliminated from the surface, and that the process of elimination is followed by a uniform deposition of Al either from the same or from a different electrolyte. C. B. A.

2249. Search for Alkali Metals in Natural Waters. R. Bossuet. *Comptes Rendus*, 202. *pp.* 1162–1164, *March* 30, 1936.—Lists are given of the localities in France in which the natural waters have been shown to contain the five alkali metals [see Abstract 3762 (1934)]. Volatilisation of traces of the rare alkali metals in the oxyacetylene flame takes place in presence of Na and K salts, and this property is used to enhance the sensitivity of Rb and Cs, of which feeble traces have been detected. N. M. B.

2250. Nature of Luminosity Accompanying Condenser Discharge in Gas. M. Laporte and (Miss) Pierrejean. *Comptes Rendus*, 202. *pp.* 643–645, *Feb.* 24, 1936.—The variation with time of the intensity of the luminosity accompanying the discharge of a condenser through a gas-tube containing A and Hg is measured, under different conditions of capacity and temperature. In the cold, the intensity passes through a number of maxima and minima and there is no marked difference between the intensities near the electrodes. The only effect of increasing the capacity is to increase the intensity. With the tube warm the variation with time is quite different in detail, although the intensity still passes through maxima and minima, and the duration of the luminosity is several times greater. D. H. F.

See also Abstracts 1909, 2011, 2105, 2152, 2166, 2178, 2298, 2319, 2328, 2329, 2330, 2335.

VISION.

2251. Visual Cycle and Protein Denaturation. A. E. Mirsky. *Nat. Acad. Sci., Proc.* 22. *pp.* 147–149, *Feb.*, 1936.—Recent knowledge of the denaturation of haemoglobin and "yellow ferment" which are both

conjugated proteins is discussed in relation to the reactions of visual purple which is also a conjugated protein. The conclusion is reached that native visual purple passes reversibly under the influence of light into denatured visual purple (visual yellow) which then decomposes reversibly into denatured protein and retinene. It is pointed out that the energy of activation for the denaturing of visual purple is about 75,000 cal./mol. which is not widely different from the energy of a light quantum at 5300 Å. W. S. S.

2252. Glare. Y. Awadi. *Tokyo Univ. Aeronaut. Research Inst., Report, No.* 133. [60*pp.*], *Feb.*, 1936. *German Abstract.*—The author carries out a series of observations on a number of subjects to determine the time taken for the eye to recover after exposure to a glaring source. Measurements are made of the dependence of this time on (a) the intensity of the glaring source, (b) its position relative to the direction of fixation, (c) the time of exposure and (d) the adaptation level of the eye. The author finds that individuals vary considerably in their susceptibility to glare, and draws the conclusion that those found to have a high susceptibility should not be occupied as pilots, engine-drivers, etc. J. W. T. W.

2253. Causes of the Different Visual Acuities of the Human Eye for White and Coloured Light. H. Schober and H. Jung. *Zeits. f. techn. Physik.* 17. 3. *pp.* 84–93, 1936.—Calculations are made of the light distribution on the retina in the image of a point source allowing for diffraction at the pupil and taking into account chromatic aberration. From the light distribution the acuity is derived by an extension of Rayleigh's method. The retinal structure is admitted as imposing an upper limit to the acuity for cone vision and for rod vision. The calculations are applied especially to the cases of monochromatic sodium light, polychromatic mercury vapour light and tungsten filament light. It is concluded that contrary to the usual view chromatic aberration plays little part in determining the relative acuities of lights of different colour but that diffraction and physiological factors are predominant. Decreasing acuity as the shorter wave-lengths are approached is, however, associated with accommodation difficulties. W. S. S.

2254. Relation between the Apparent Intensity of a Beam of Light and the Angle at which the Beam Strikes the Retina. W. D. Wright and J. H. Nelson. *Phys. Soc. Proc.* 48. *pp.* 401–405, *May* 1, 1936.—Stiles and Crawford [see Abstract 4601 (1934)] recently observed that the efficiency of a pencil of light was much greater when it passed through the centre of the lens of the eye than when it traversed an outer segment. This result is confirmed for three observers by use of the authors' subjective photometer [see Abstract 164 (1936)] in which a method of binocular matching is employed. One or two suggestions as to the origin of the phenomenon are put forward; it is almost certainly associated with the angle of incidence of the light on the retina, which may have an inherent directional sensitivity. AUTHORS.

2255. Retinal Image of a Distant Point for Different Pupil Sizes. C. Lapicque. *Comptes Rendus*, 202. *pp.* 656–659, *Feb.* 24, 1936.—The distribution of light in the retinal image of a distant point source of white light (equi-energy spectrum) is computed for different pupil sizes allowing for diffraction, for the relative luminosities of different parts of the spectrum and for the chromatic aberration of the eye. Spherical aberration is neglected as it has been found that up to the maximum pupil size studied

(5 mm. dia.) this aberration has little effect. For constant light flux entering the eye, the illumination at a given point in the retinal image is subject to wide variations with change of pupil size. For the larger pupil sizes the calculations indicate that the bright centre of the image is surrounded by a halo which, however, may not be visible so that the size of the image as perceived is determined by diffraction only. W. S. S.

See also Abstracts 2165, 2167, 2183, 2410.

X-RAYS.

***2256. X-Rays : Edited by G. W. C. Kaye. Part I. Production of X-Rays. G. E. Bell. Part II. Ionisation in Gases, Absorption and Scattering of X-Rays. I. Backhurst. Part III. X-Ray and γ-Ray Quantity or Dose. Protection. W. Binks. Part IV. Radium. W. E. Perry. Part V. X-Ray Spectroscopy. G. Shearer. Part VI. Crystal Structure of Metals and Inorganic Substances. W. A. Wood. Part VII. Crystal Structure of Organic and Biological Substances. J. Thewlis.** *Phys. Soc., Reports*, 2. *pp.* 300–328, 1935.

2257. Atomic Scattering Factor for X-Rays. T. Derenzini. *N. Cimento*, 13. *pp.* 16–32, *Jan.*, 1936.—Brief discussion of the theory of X-ray interference in crystals. The application of the classical and wave-mechanical theories to the calculation of the atomic scattering factor is outlined. C. J. B. C.

2258. Atomic Scattering Factors of Al, Ni and Cu for CuKα Radiation, and their Relation to the Theory of X-Ray Dispersion. G. W. Brindley. *Phil. Mag.* 21. *pp.* 778–790, *April*, 1936.—Previously established values standardised against KCl have been redetermined against Al. KCl has the advantages of being readily obtained pure and of suitable crystal size. Al paint powder consists of flakes with a preferred orientation, and sprayed Al is too coarse. A suitable powder can be obtained by filing, apparently without lattice distortion, as shown by perfect resolution of the $K\alpha_1\alpha_2$ doublet. It is suggested that with Al, Cd and Zn, spontaneous annealing takes place, while Ni and Cu, with higher melting points and recrystallisation temperatures, show considerable distortion in the filings. The revised scattering factors are about 10 % higher than the previous values and agree well with theoretical determinations, particularly in the region $(\sin\theta)/\lambda = 0{\cdot}4$, where KCl standardisation had shown anomalies. Data are given for the intensities of X-ray reflections from Al, allowance being made for the effect of dispersion on the scattering factor. Average values of $(f_0 - f_{Cu}\,\kappa_a)$ are 3·51 for Ni and 2·61 for Cu, in good agreement with theoretical values of 3·53 for Ni and 2·55 and 2·3 for Cu. [See following Abstract.] D. R. H.

2259. X-Ray Investigation of Atomic Vibrations in Zinc. G. W. Brindley. *Phil. Mag.* 21. *pp.* 790–808, *April*, 1936.—The atomic scattering factor of Zn and Cd for Cu$K\alpha$ radiation is not a smooth function of $(\sin\theta)/\lambda$, reflecting planes at small angles to the basal plane give values too low, and planes approximately at right angles give values too high. The effect is similar both for filings and for condensed particles. These results are consistent with the amplitude of thermal vibration being greater in the c axis. Results show fair correlation with theoretical values after correction of the latter for lattice vibration by Zener's method based on elastic constants [see Abstract 1243 (1936)] or by a more approximate method devised by the author. The deduced scattering values for a

theoretical stationary atom should be a smooth function of $(\sin\theta)/\lambda$. The author's method obtains a better correlation than Zener's. For CuKα radiation reflected from Zn, the effect of dispersion is important and when allowance is made for this, good correlation is shown between the theoretical scattering factor and the experimental scattering factor corrected for lattice vibration. [See preceding Abstract.] D. R. H.

2260. Variation of the Atomic Structure Factor of Potassium with X-Ray Wave-Length. S. K. Allison and W. P. Jesse. *Phys. Rev.* 49. *pp.* 483–494, *April* 1, 1936.—A vacuum ionisation spectrograph is constructed for the comparison of the diffracted power in the Debye-Scherrer rings from NaCl, NaF, LiF and KF powders. In the work on KF a range of wave-lengths from 1·538 Å to 4·146 Å is used. On the short wave-length side the expected decrease of crystal structure factor of KF was observed, and beyond the K-edge of potassium it rose again. Hönl's computations based on the wave-mechanical theory of X-ray dispersion do not give correctly the differences in structure factor for the (200) halo of KF on the long or short wave-length side of the potassium K-edge. C. J. B. C.

2261. Absorption of X-Rays by Lead Glasses and Lead Barium Glasses. G. Singer. *Bureau of Standards, J. of Research*, 16. *pp.* 233–251, *March*, 1936.—The results of a study of the protective properties of a group of typical flint and barium-flint glasses are reported. In chemical composition, the protective glasses analysed are found to resemble closely the denser optical flint and barium-flint glasses. The protection coefficients of the glasses are determined by an ionisation method; of the various component elements it is found that only lead and barium contribute appreciably to the protective effectiveness of the glasses. For flint glass empirical relations are established between the protection coefficient and the chemical composition, density, and refractivity; for barium-flint glass an empirical relation is given between the protection coefficient and the lead-oxide and barium-oxide components of the glass. Author.

2262. Auger Effect and Relative Intensity of I-Emission Lines. D. Coster and K. W. de Langen. *Physica*, 3. *pp.* 282–288, *April*, 1936. *In English.*—The relative intensities of the lines $L\beta_1$, $L\beta_3$, and $L\beta_4$ are determined for Ag, Sn and Sb by a photographic method. As these lines originate respectively from the levels L_{II}, L_I and L_I, it is possible to study for them the influence of the Auger effect $L_I \rightarrow L_{III}$ with ejection of an M-electron to which attention was drawn by Coster and Kronig [see Abstract 1693 (1935)]. This Auger effect can take place for Ag, but no longer for Sn and Sb, since for them the energy difference $L_I - L_{III}$ is too small. In accordance with the expectation the intensity ratio $\beta_3 : \beta_1$ and $\beta_4 : \beta_1$ is markedly greater for Sn and Sb than for Ag, where a larger proportion of the atoms in the state L_I is drained away by radiationless transitions. Authors.

2263. Demonstration and Measurement of the Index of Refraction of Crystals for X-Rays. H. C. Hoyt and G. A. Lindsay. *Phys. Rev.* 49. *pp.* 498–501, *April* 1, 1936.—An X-ray spectrum line may be formed by reflection at the surface of a crystal even if that surface is not parallel to the atomic planes concerned in the reflection. If two faces are good very close to the line of their intersection, then, using a slit that is not too narrow, the same line may be reflected simultaneously from these two faces of a stationary crystal by turning it so that for the proper reflecting angle the rays must fall at the intersection. If the wave-length

of the line is such that the reflected beam from the bevelled face almost grazes the surface, then that portion will be refracted much more than the portion of the line reflected from the other face, and the two parts of the line are plainly separated. A very simple calculation gives the index of refraction from the width included between the two portions of the line. In this way δ/λ^2 for a cerussite crystal has been found to agree fairly well with the calculated value. AUTHORS.

*2264. **K-Series of Al, Mg and Na. V. Kunzl.** *Zeits. f. Physik*, 99. 7. 8. *pp.* 481–491, 1936.—Dolejsek's l.v. ionic tube [see Abstract 2855 (1932)] is developed so that it can be applied not only to the study of metallic but also to chemically combined elements. In combination with a previously described focusing method [see Abstract 5082 (1935)] it is used to investigate the K-series of light elements. With this arrangement hitherto unknown lines in the α- and β-groups of the K-series of Al, Mg and Na are observed. J. E. K.

2265. **Intensity Ratio of the $\alpha + \alpha'$ and $\beta + \gamma$ Lines in the K-Radiation of Elements 27Co to 52Te. W. Grothey.** *Ann. d. Physik*, 25. 7. *pp.* 577–599, *April*, 1936.—Küstner's absorption method of determining $E_{\alpha\alpha'}/E_{\beta\gamma}$ is developed and extended; the results are shown to be not much affected by the condition of the radiator surface or by the lighter components of the compounds used. This ratio is obtained with a 6 % accuracy for 20 elements (or light-atom compounds) between 27Co and 52Te. It diminishes steadily as Z increases, becoming constant at 47Ag, and nowhere giving a sudden jump. The results agree well with those of Unnewehr (Cr, Cu, Rh) and Küstner (Cu). In 39Y an 18 % impurity of heavier atoms produces a large deviation which is quantitatively accounted for. A secondary-radiation emission method of finding the ratio is described and applied to 30 Zn and 51Sb; in comparison with the former method its results agree for Zn but diverge by 15 % for Sb, and are very sensitive to small observational errors. From the determined ratio $E_{\alpha\alpha'}/E_{\beta\gamma}$ and the known coefficient u_K the coefficients $u_{\alpha\alpha'}$ and $u_{\beta\gamma}$ are obtained. Accurate absorption measurements near the K-edges show that the exponent n of λ in the absorption formula is smaller on the short-λ than on the long-λ side for all the elements investigated. W. J.

2266. **K X-Ray Absorption Spectra of Compounds of Bromine and Rubidium. S. T. Stephenson.** *Phys. Rev.* 49. *pp.* 495–498, *April* 1, 1936.—The K X-ray absorption spectrum of Br in KBr, RbBr, $CdBr_2$, and $NaBrO_3$ and of Rb in RbBr is obtained by using powder absorbing screens with a double crystal ionisation spectrometer. Methyl iodide is used in the ionisation chamber to eliminate the effect of Br in methyl bromide. The width of the Br edge is about 9 V and of the Rb edge about 11 V. The positions of secondary fine structure discontinuities are given and discussed. No discontinuity due to a possible simultaneous ejection of K and L electrons is observed. AUTHOR.

2267. **Excitation Potential, Relative Intensities and Wave-Lengths of the Kα'' X-Ray Satellite Line. L. G. Parratt.** *Phys. Rev.* 49. *pp.* 502–507, *April* 1, 1936.—With a two-crystal vacuum spectrometer, ionisation curves of the Kα'' satellite line are recorded for elements S(16) to V (23). This satellite line, on the short wave-length side of and very close to the $K\alpha_1$ line, was observed in 1922 by Dolejšek and has been until now a forgotten line. The excitation potential of this satellite is determined: the initial atomic state for its emission appears to be one of KM ionisation. The Kα'' intensity relative to the $K\alpha_1$ intensity varies with

atomic number, reaching a maximum of 2·3 % at Ca(20). The $K\alpha''$ wave-length positions are also determined for each element. The observed data are compatible with both the Wentzel-Druyvesteyn and the Richtmyer theories for the origin of this satellite line. AUTHOR.

2268. X-Rays in Industry. V. Hicks. *Physics*, 7. *pp.* 79–84, *March*, 1936.—X-ray radiography is industrially useful in the physical inspection of welded, cast, or assembled products. X-ray diffraction analysis contributes to the understanding of the details of the processes of manufacturing and treatment of alloys, ceramics, glasses, textiles, and other materials. Both applications have led to the control and improvement of industrial processes and products. AUTHOR.

2269. X-Ray Analysis of Copper-Tin Alloys. E. A. Owen and E. C. Williams. *Inst. of Metals, J.* 58. [8 *pp.*], 1936. *Advance Copy.*—An account is given of a further study of copper-tin alloys by X-ray analysis. Attention is particularly directed to the δ and η phases. The δ region was examined at temperatures below 550° C. and it was found to be a solid solution, the range of solution increasing from zero at the eutectoid point which occurs at a composition of $67{\cdot}4_5$ % Cu and a temperature of 330° C., to $0{\cdot}4_8$ % composition by weight at 550° C. The η-phase was also found to be a solid solution, the range of solution at 250° C. extending from 61·68 to 62·10 and at 530° C. from 61·68 to 62·20% Cu by weight. Observations are also recorded which confirm the conclusion that the δ-phase transforms to $(\alpha + \eta)$ at a temperature of 330° C. approximately. [See also Abstract 4304 (1935).] AUTHORS.

***2270. Vacuum Chamber for X-Ray Fine Structure Photography with Varied Applicability. E. Franke.** *Zeits. f. phys. Chem.* 31. *Abt.B.* 6. *pp.* 454–458, 1936.—A description is given of a vacuum chamber which ensures high precision of the photographs with great handiness and varied suitability. J. J. S.

See also Abstracts 1931, 1957, 1958, 2283, 2415, 2417, 2418.

HEAT.

CALORIMETRY.

***2271. Specific Heats of Sodium Hydroxide Solutions. J. W. Bertetti and W. L. McCabe.** *Indust. and Engin. Chem.* 28. *pp.* 375–378, *March,* 1936.—Adiabatic calorimeters used for the determination of the specific heat of NaOH solutions are described and illustrated. The determinations were made over the temperature range 3·1 to 88·5° C. and for concentrations of from 4 to 51 % by weight of NaOH. No other workers have covered so wide a range, but so far as comparison can be made the present results are in agreement with the data of Richards and Gucker, Gucker and Schminke, and Thomsen, but are higher than those of Tucker. R. W. P.

2272. Heat Capacity Data for Benzene Derivatives and Heterocyclic Compounds. G. S. Parks, S. S. Todd and W. A. Moore. *Am. Chem. Soc., J.* 58. *pp.* 398–401, *March,* 1936.—The specific heats of six typical benzene derivatives and of pyridine and quinoline are measured between liquid-air temperatures and that of the room. Heats of fusion are also determined in five cases. The entropies of the eight compounds are calculated from these heat capacity data. In general, the results are in good agreement with the corresponding values predicted by the use of some empirical entropy regularities, but a revision of the entropy contribution of the SH group is necessary. The corresponding free energies for seven of these compounds are also calculated. AUTHORS.

***2273. Specific Heats of Liquid CCl_4 at High Temperatures. G. Damköhler.** *Zeits. f. phys. Chem.* 31. *Abt.B.* 6. *pp.* 439–453, 1936.—In a liquid with rising temperature a transition takes place from the molecular form of motion characteristic of the crystal vibration (which in liquid may occur as translational and rotational vibration of the molecule) to the molecular form of motion in gas, *viz.*, free translation and free rotation. In the region of validity of the classical calculation a difference of the specific heats $C_v - C_s$ is to be expected, where C_v = the amount of heat at constant volume, and C_s = that portion which arises from the atomic vibrations inside the molecule. In fact A. Eucken and F. Hanck have observed such a difference of C_v with rising temperature in liquid A and liquid air. Their measurements on CO_2 show for $C_v - C_s$ a rise with rising temperature which was not to be expected from current hypotheses. It seemed therefore desirable to extend the measurements of specific heats from liquids to other substances. CCl_4 is taken as a specially simple example where C_s likewise can be accurately calculated. For this substance the isentropic cooling effect with adiabatic relaxation was determined in a range of temperature between room-temperature and 200° C., and from this with use of the coefficient of expansion, obtained also for this same range of temperature, and isothermal compressibility there was calculated the specific heats C_v and C_p for a pressure of 26 atmospheres. Details of the apparatus used and the results obtained are given and these results are compared with those of other investigators. J. J. S.

2274. Specific Heat of Lithium. G. Pankow. *Helv. Phys. Acta,* 9. 2. *pp.* 87–122, 1936. *In German.*—The fall in the specific heat of Li, as well as of Na, K and Si, from the Dulong-Petit value to almost zero is

anomalous, in that it is not deducible from the theoretical Debye function. These elements show a cubic crystal structure and experiment shows that the temperature change of specific heat may be calculated from the Debye function of a monatomic cubic crystal. In the explanation of this phenomenon offered by Simon, it is assumed that only part of the heat supplied to the substance serves to increase the atomic vibrations, the remainder being used up in inter-atomic rearrangements. The author then attempts to verify this assumption by employing an X-ray method for measuring the interference patterns as a function of the temperature ; a direct estimation may be made from these results of the amplitude of the atomic vibrations. Filtered Cu radiation is used and the intensity of the lines of the Debye-Scherrer pattern of Li is measured for temperatures between that of the room and of liquid air. A characteristic temperature of 352 $\pm$ 12° C. is obtained ; this value is lower than that given by Simon (510° C.) but is in agreement with a value of 363° C. found by Gruneisen by electrical resistance measurements and of 350° C. by Ruhemann at temperatures near 25° K. The characteristic temperature appears to fall with decreasing temperature ; Simon and Swain find a value of 328° C. at 15° K. If the Debye-Waller theory of the temperature-intensity relation for X-ray interference is assumed for the case of the cubic body-centred lattice, it is shown that nearly all the heat supplied to Li is used up in increasing the atomic vibrations. Suggestions are made to account for the discrepancies between the experimental and theoretical work. A complete Bibliography is appended. H. J. H. S.

2275. Atomic Heats and Latent Heats of Fusion of Neon, Argon and Krypton. K. Clusius. *Zeits. f. phys. Chem.* 31. *Abt.B.* 6. *pp.* 459–474, 1936.—The atomic heats of Ne, A and Kr are determined from 10° Abs. to their melting points. The latent heats of fusion are also measured. It is found in Ne at the melting point that the Dulong-Petit limiting value of atomic heat is not reached. The results are discussed and it is shown that the effect of zero-point energy is appreciable in Ne, but not in A and Kr. L. G. C.

2276. Properties of Heusler's Alloy, and Specific Heat of Manganese. J. R. Ashworth. *Phys. Soc., Proc.* 48. *pp.* 456–467 ; *Disc.*, 468, *May* 1, 1936.—The physical properties of Heusler's alloy are examined. The experiments, always carried out on the same specimen, comprise determinations of density, intensity of magnetisation, critical temperature, Curie's constant, electrical resistivity and its temperature coefficient, thermoelectric power and mean and true specific heat. A determination is made of the true specific heat of the metal manganese and a large discontinuity is found at about 350° C., which is near to the critical temperature of Heusler's alloy. It is further found that the heat-capacity of the alloy is the sum of the heat-capacities of its constituents both below and above the critical temperature, thus following Regnault's rule, and the same rule can be applied to magnetite. Author.

2277. Heats of Evaporation of Ternary Mixtures. V. Fischer. *Ann. d. Physik*, 25. 8. *pp.* 728–736, *April*, 1936.—It has been shown previously [see Abstract 3664 (1933)] that the heats of admixture of binary mixtures may be calculated from the experimentally determined heats of evaporation, and in the present paper it is shown that in the cases of ternary mixtures, the energy changes may be evaluated when the heats of evaporation of the mixtures are known. The paper commences by a discussion of the heats of evaporation of ternary mixtures and the differ-

ences which exist between binary and ternary mixtures. An expression is then derived for the heat of evaporation at constant pressure and temperature, and subsequently utilised for the calculation of heats of admixture and entropy changes, which quantities are then introduced into the equations for the evaluation of the equilibrium isobars and isotherms.

H. H. Ho.

See also Abstracts 2285, 2288, 2296, 2396.

CONDUCTION.

2278. Thermal Conductivity of Tungsten. W. C. Michels and Martha Cox. *Physics*, 7. *pp.* 153–155, *April*, 1936.—The theory of the heat losses from an electrically heated wire, as given by Roberts and Kannuluik, is extended to include a wire supported by springs. The results obtained are used in a measurement of the thermal conductivity of commercial tungsten wire in the temperature range from 78° K. to 273° K. There are definite indications that the Wiedemann-Franz law breaks down badly in this region. AUTHORS.

2279. Thermal and Electrical Conductivities of Metals and Alloys: Part II. Heat-Resistant Alloys from 0° C. to 800° C. R. W. Powell. *Phys. Soc., Proc.* 48. *pp.* 381–392, *May* 1, 1936.—A comparative longitudinal-flow method is used to determine the thermal conductivities up to temperatures approaching 800° C., of F.N.C.T., F.H. stainless, Staybrite and Era A.T.V. steels, and of monel metal and an alloy composed of approximately 80 % of Ni and 20 % of Cr. The values are derived in terms of the thermal conductivity of a specimen of nickel-plated iron which had been previously tested over the full temperature-range. Determinations of the electrical resistivity are made in the course of the same experiment, and values of the Lorenz function are derived. Whereas at atmospheric temperature the values of the Lorenz function for these metals are abnormally high, and vary from $0{\cdot}76 \times 10^{-8}$ for the F.N.C.T. steel to $1{\cdot}18 \times 10^{-8}$ for the F.H. stainless steel, they decrease towards a common value with increase in temperature, and at 800° C. all lie between $0{\cdot}62 \times 10^{-8}$ and $0{\cdot}68 \times 10^{-8}$. An examination of values obtained for the Lorenz function of metals by other workers reveals that the extreme values so far published for this function for this function over the temperature-range 400° to 1000° C. are $0{\cdot}56 \times 10^{-8}$ and $0{\cdot}08 \times 10^{-8}$. It is concluded that the thermal conductivity of a metal can be predicted with a fair degree of approximation over this range of temperature from a knowledge of the electrical resistivity, and that in general the probable error involved decreases as the temperature increases. [For Part I see Abstract 3793 (1934).] AUTHOR.

See also Abstract 2288.

CONVECTION.

2280. General Laws of Natural Convection. Conditions for the Appearance of the First Régime. P. Vernotte. *Comptes Rendus*, 202. *pp.* 733–735, *March* 2, 1936.—Attention is drawn to the difficulty of deciding when the laws for natural convection cease to hold and should be replaced by those for forced convection. Two cases are examined theoretically: that of a fluid contained in the space between two concentric spheres, the inner one being heated, and that of a horizontal cylinder. For the latter case the transition should occur when Péclet's number has a

value of about unity. Bory's experiments [see Abstract 3555 (1935)] are in agreement with this. R. W. P.

2281. Dissipation of Heat by Forced Convection and Determination of the Coefficient of Turbulence. M. Luntz and A. Japy. *Comptes Rendus*, 202. *pp.* 821–823, *March* 9, 1936.—A formula is derived by means of which the coefficient of turbulence can be deduced from a single temperature measurement made in the air stream in the wake of a heated Pt wire. If the wire is at the origin and the wind blows with velocity U in the direction of the x axis the temperature at a point having coordinates (x,y) is given by $QB^2e^{-B^2y^2x^{-2}}/\pi\rho cUx^2$, where Q is the heat dissipated by the wire, ρ the fluid density, c its specific heat at constant pressure, and B is the coefficient of turbulence. R. W. P.

See also Abstracts **1992, 2288.**

DILATATION.

2282. Negative Coefficient of Expansion of Silver Iodide. E. Cohen and H. L. Bredée. *K. Akad. Amsterdam, Proc.* 39. 3. *pp.* 358–360, 1936.—Fizeau in 1867 obtained the negative value $-4{\cdot}1 \times 10^{-6}$ for the coefficient of cubical expansion of AgI at about 40° C. The coefficient is negative from − 10° C. to + 70° C. Jones and Jelen [see Abstract 748 (1936)] find the value $-1{\cdot}6 \times 10^{-6}$ for the coefficient between 20° and 60° C. In the present paper it is pointed out that the low value obtained by Jones and Jelen is due to the fact that the AgI used by them was not physically pure, but consisted of a mixture of meta-stable β-iodide with the stable α-iodide. The transformation of the β-modification into the α-modification on heating is accompanied by an increase of volume. J. S. G. T.

2283. X-Ray Measurement of the Thermal Expansion of Pure Nickel. E. A. Owen and E. L. Yates. *Phil. Mag.* 21. *pp.* 809–819, *April*, 1936.—The thermal expansion of the crystal lattice of 99·98 % pure Ni is measured over the temperature range 12° C. to 600° C. The structure remains face-centred cubic throughout. The Ni parameter at 18° C. is $3{\cdot}5172_4$ Å and its density 8·897 gm. per c.c. An abnormally high rate of expansion, followed by a rapid decrease, is found in the region of the temperature of magnetic transformation; the maximum value of the coefficient occurs at 370° C. The ferromagnetic change in length per unit length observed is $2{\cdot}4 \times 10^{-4}$, which is much higher than any previously reported value. C. J. B. C.

2284. Thermal Stress in a Strip. J. N. Goodier. *Physics*, 7. *pp.* 156–159, *April*, 1936.—The thermal stress developed by unequal heating of a flat strip is investigated, the temperature varying along the length and through the thickness, but not across the width. The problem is reduced to one of edge tractions only, for which general solutions are already known. From the properties of these solutions it is shown that for heating local to a narrow transverse band across the width, as might occur in welding processes, there is a concentration of stress near the edge of the strip, at the hottest part, and a maximum tensile stress of magnitude $E\alpha T_{max.}$, when the temperature is constant through the thickness. The corresponding quantity is found also for temperatures varying through the thickness. For steel $E\alpha T_{max.} \doteqdot 350\ T_{max.}$ pounds per in.^{2}, the temperature being measured in °C. above that of the cool parts of the strip, and this approaches the yield point of mild steel for a maximum temperature

(rise) of the order of 150° C. For a given maximum temperature, the maximum stress is reduced by about 40 % by keeping one face cold.

AUTHOR.

See also Abstracts 1942, 2288, 2387.

MELTING AND BOILING POINTS.

2285. Ebullioscopic Constants. C. Duval. *Comptes Rendus*, 202. *pp.* 660–662, *Feb.*, 24, 1936.—It is shown that the equation $MT/K = 1050$ (M = mol. wt., T = boiling point (°Abs.), and K = ebullioscopic constant) is obtained when L, the latent heat of vaporisation at T, is eliminated from the van 't Hoff and Trouton equations. 21 substances, taken at random, are tabulated for which the value of the ratio ranges from 1000 to 1120, the mean being 1054. Other cases to which this equation applies are mentioned, and the suggestion is made that it can be used as a means of determining ebullioscopic constants when L is not known. R. W. P.

***2286. Distillation and Separation of Arsenic, Antimony and Tin. J. A. Scherrer.** *Bureau of Standards, J. of Research*, 16. *pp.* 253–259, *March*, 1936.—This paper describes an apparatus and the technique for the separation, by distillation, of As, Sb and Sn from one another and from elements having non-volatile chlorides. The apparatus is made entirely of glass, for it is found that cork and rubber stoppers absorb the vapours to such an extent that significant errors may ensue. AUTHOR.

See also Abstracts 1968, 1999, 2055, 2290, 2291, 2455, 2456.

TEMPERATURE, MEASUREMENT OF.

***2287. Localisation of Transition Points in Metals and Alloys by a Modified Saladin—le Chatelier Method. E. Rosenbohm and F. M. Jaeger.** *K. Akad. Amsterdam, Proc.* 39. 3. *pp.* 366–374 and 374–383, 1936.—Two galvanometers rigidly mounted on the same support are optically coupled by means of a lens system which converts the original horizontal motion of the image to a vertical motion subsequently reflected by the second mirror and eventually giving a record on a photographic plate. Sensitivity of the instruments is adjusted to a suitable value by trial. The second galvanometer is connected to a thermo couple in the usual way, the first to a differential thermo-couple, the specific heat of the comparison metal being about equal to that of the substance under investigation. The $\alpha \rightleftharpoons \beta$ change in Ni (against Cu) and the transition points in $AuSb_2$ (against Ag) are investigated. By using a specimen in the form of wire as one arm of a Wheatstone bridge, with the first galvanometer as diagonal, resistance is photographically plotted against temperature. A correction is applied for parasite e.m.f.s and for temperature-resistance effects. Data are given for the resistivity-temperature values for Ni, both *in vacuo* and in H_2. D. R. H.

***2288. Heat. J. H. Awbery.** *Phys. Soc., Reports*, 2. *pp.* 188–220, 1935.

***2289. Measurement of Rapidly Changing Gas and Liquid Temperatures. H. Pfriem.** *Forsch. IngWes.* 7. *pp.* 85–92, *March–April*, 1936.—The measurement of quickly changing temperatures is invariably complicated by the lag introduced by the heat capacity of the measuring instrument. The problem is treated mathematically, and a method developed by which the true temperatures can be derived from observations made either with two resistance thermometers of different

diameter wire carrying the same current, or with two similar thermometers heated by different currents. The method is applied to determine the temperature-time curve within an air-compressor. R. W. P.

***2290. Low-Temperature Technique. W. Meissner.** *Die Physik*, 4. 1. *pp.* 1–16, 1936.—A review of contributions made during the past three years to subjects relating to the production of low temperatures. The aspects considered include heat transfer, properties of refrigerants, refrigerating machines, solid CO_2, separation and liquefaction of gases, and production of temperatures below 1° K. R. W. P.

***2291. Very Low Temperature Apparatus. H. R. Lang.** *Engineering*, 141, *pp.* 294–295, *March* 13, 1936.—A description is given of the exhibition of very low temperature apparatus arranged at the Science Museum, London. The items dealt with include the production and measurement of low temperatures; the measurement of low pressures; the liquefaction of gases, equipment for their storage and transport; commercial applications, and properties of materials at low temperatures. R. W. P.

***2292. Low-Temperature Thermostat. G. B. Heisig.** *Indust. and Engin. Chem.* (*Analytical Edition*). 8. *p.* 149, *March* 15, 1936.—A thermostat operated by means of solid CO_2 enables temperatures between 25° and − 75° C. to be maintained. The construction is simple and comprises a series of breakers, insulated from each other, the innermost beaker containing the fluid, which may be acetone, alcohol or kerosene, cooled by solid CO_2. The liquid is cooled continuously so that a heating coil which is automatically controlled by means of a bimetallic strip enables the temperature of the liquid to be kept steady at any given temperature. It is claimed that the temperature remains constant to $\pm 0{\cdot}01°$ C. H. J. H. S.

2293. Temperature Equilibria at Very Low Temperatures. N. Kürti, B. V. Rollin and F. Simon. *Physica*, 3. *pp.* 266–274, *April*, 1936. *In English.*—The time necessary for the establishment of temperature equilibrium between a paramagnetic salt and liquid helium is determined. These experiments show that the time constant for the equilibrium spin system-lattice is smaller than 30 sec. at 0·2° K. In further experiments the heat conductivity within the paramagnetic salt is roughly determined between 0·07 and 0·16° K. The heat conductivities of iron ammonium alum and chromium potassium alum are found to be of the order of 10^{-5} cal/deg. cm. sec. As a result of these small heat conductivities together with the anomalous specific heats of the paramagnetic salts concerned, the time necessary for the establishment of temperature equilibrium within the salt is very considerable (10^2–10^3 sec. for 1 cm. linear dimensions). The results of both experiments are discussed, furthermore some practical consequences related to the experimental technique and to the application of nuclear paramagnetism for attaining still lower temperatures in a second stage. AUTHORS.

2294. Physical Properties of Surfaces. Part III. Surface Temperature of Sliding Metals and Temperature of Lubricated Surfaces. F. P. Bowden and K. E. W. Ridler. *Roy. Soc., Proc.* 154*A*. *pp.* 640–656, *May* 1, 1936.—A method is described for measuring the surface temperature of sliding metals [see also Abstract 3937 (1935)]. The temperature reached depends upon the load, speed coefficient of friction, and thermal conductivity of the metals, and is in good agreement with theory. With readily fusible metals the surface temperature reached

corresponds to the melting point of the metal. With less fusible metals the local surface temperature may exceed 1000°C. Even with lubricated surfaces the temperature (under boundary lubrication conditions) is high and may exceed 600° C. This high surface temperature will cause a local volatilisation and decomposition of the lubricant, and is a cause of the breakdown of the boundary film. [For Part II see Abstracts 3337 (1935).] AUTHORS.

See also Abstracts 2108, 2203. 2330.

THERMOCHEMISTRY.

2295. Heat of Combustion and Heat of Sublimation. H. C. Blanck and K. L. Wolf. *Zeits. f. phys. Chem.* 32. *Abt.B.* 2. *pp.* 139–144, 1936.—The results of measurements of heats of combustion and sublimation are given and discussed in connection with " intermolecular " forces on inner-molecular action. J. K.

2296. Heat of Formation and Specific Heat of Aluminium Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 624. *pp.* 19–30, *March,* 1936. *In English.*—The mean specific heat of AlN is measured by the ice calorimeter in three temperature intervals, 0° C. ~ 100° C., 0° C. ~ 420° C. and 0° C. ~ 598° C., and the equation of the true specific heat is obtained: $C = 0{\cdot}1803 + 2{\cdot}75 \times 10^{-4}t - 1{\cdot}937 \times 10^{-7}t^2$. By using this equation, the heat of formation of AlN is computed from the equilibrium data of the reaction $Al_2O_3 + 3C + N_2 = 2AlN + 3CO$ at high temperatures. The result obtained is 74,700 cal. AUTHOR.

2297. Free Energy of Ethylene Hydration. E. R. Gilliland, R. C. Gunness and V. O. Bowles. *Indust. and Engin. Chem.* 28. *pp.* 370–372, *March,* 1936.—Within an accuracy of ± 500 cal. the free energy change for the hydration of ethylene, $C_2H_4(g) + H_2O(g) \rightarrow C_2H_5OH(g)$ is given by the expression, $\Delta F^\circ = 26{\cdot}9T - 8300$. This equation is based on all available experimental data and is applicable over a range of temperature from 150° to 380° C. The newer heat of combustion of ethanol offered by Rossini is probably more accurate than the older value of 328,700 cal. The specific heat of ethylene used by Francis and Kleinschmidt is not as accurate as that used by Parks and Huffman. AUTHORS.

2298. Influence of Surrounding Gas Pressure on Luminosity Accompanying Detonation of Explosives. A. Michel-Lévy and H. Muraour. *Comptes Rendus,* 202. *pp.* 755–757, *March* 2, 1936.—The results obtained show that an increase of pressure of the surrounding gas has the effect of considerably decreasing the intensity of the luminosity and of making the transmission of the detonation from granule to granule much more difficult. For equal pressures, however, the transmission is more easily effected with A as the surrounding gas in place of CO_2. With pressures below atmospheric a luminous cloud is obtained, this luminosity being produced by shock. [See Abstracts 238 and 766 (1936).] R. C. F.

2299. Explosion and Continuous Waves in Gases. E. Jouguet. *Comptes Rendus,* 202. *pp.* 796–799, *March* 9, 1936.—A mathematical study of explosion and continuous waves in CO_2, N_2 and A. The results obtained are intended for use in the investigation of the waves produced by a solid explosive detonating in a gaseous atmosphere. H. H. Ho.

See also Abstract 2282.

THERMODYNAMICS.

2300. General Constant of van der Waals. R. Lautié. *Comptes Rendus*, 202. *pp.* 1059–1061, *March* 23, 1936.—According to the theory of corresponding states, van der Waals found that the vapour pressure P was related to the absolute temperature T by the formula $\log P_c/P = a_1 (T_c/T - 1)$, and when the experimental value of a_1, did not fall between 2·8 and 3·2, he concluded that the liquid was abnormal. In view of the incorrect character of this conclusion, the present author has derived 2 new constants viz., $a_2 = M_e\lambda_e/4{\cdot}571T_e(1 - 1/P_e)$, and $a_3 = 0{\cdot}7621 \log T_e + 0{\cdot}5822 + 0{\cdot}001322\ T_e$, where M_e, λ_e, T_e and P_e are respectively the molecular weight of the vapour at T_e, the latent heat of evaporation at T_e, and the absolute critical temperature and pressure. If the theory of van der Waals is rigidly true, then $a_1 = a_2$. A study of available experimental data shows that the van der Waals rule does not apply to normal liquids at critical temperatures below 300° K., that the van der Waals constant is an increasing function of T_e, and that the above constants are useful for testing cases of polymerisation. H. H. Ho.

2301. Critical Solution Temperatures of Aliphatic Acids with Nitromethane. G. Broughton and D. C. Jones. *Faraday Soc., Trans.* 32. *pp.* 685–689, *April*, 1936.—The critical solution temperatures of caproic, caprylic, pelargonic, lauric, palmitic and stearic acids with nitromethane are determined and found to increase regularly with increasing molecular weight of the acid. The effect of homologues upon the critical solution temperatures is also investigated. Authors.

2302. Limiting High-Temperature Rotational Partition Function of Non-Rigid Molecules. L. S. Kassel. *J. Chem. Phys.* 4. *pp.* 276–282, *April*, 1936.—The method given by Eidinoff and Aston [see Abstract 3572 (1935)] for calculating the limiting high-temperature rotational partition function is further simplified. An important special case, comprising molecules which may be represented by a rigid framework to which symmetrical tops are attached in any position is developed. The methods are applied to the series of methyl derivatives of methane, and to the completely non-rigid molecule *n*-butane. The calculated entropies at 25° C. show the same general variation with chain length and number of branches as has been found experimentally from the third law. The entropies of all the isomeric methyl derivatives of benzene are calculated. Comparison with third law values for the liquids is hampered by lack of reliable vapour pressure data and of vibration frequencies, but there are no major discrepancies which must be attributed to either the calculated or the observed entropies. Author.

2303. Viscosity, Plasticity and Diffusion as Examples of Absolute Reaction Rates. H. Eyring. *J. Chem. Phys.* 4. *pp.* 283–291, *April*, 1936.—Since to form a hole the size of a molecule in a liquid requires almost the same increase in free energy as to vaporise a molecule, the concentration of vapour above the liquid is a measure of such " molecule " holes in the liquid. This provides an explanation of the law of rectilinear diameters of Cailletet and Mathias. The theory of reaction rates yields an equation for absolute viscosity applicable to cases involving activation energies where the usual theory of energy transfer does not apply. This equation reduces to a number of the successful empirical equations under the appropriate limiting conditions. The increase of viscosity with shearing stress is explained. The same theory yields an equation for the diffusion coefficient which when combined with the viscosity and applied to

the results of Orr and Butler for the diffusion of heavy into light water gives a satisfactory and suggestive interpretation. The usual theories for diffusion coefficients and absolute electrical conductance should be replaced by those developed here when ion and solvent molecule are of about the same size. AUTHOR.

2304. Endothermic Processes of Nitrogen Fixation. N. I. Kobosew, S. S. Wassiljew and J. S. Kasarnowsky. *Acta Physicochimica*, 4. 2. *pp.* 245–262, 1936. *In English.*—The problem of N-fixation is studied from the standpoint of: (1) The equilibrium concentrations of fixed N to be expected for a given reaction at different temperatures and pressures. (2) The specific expenditure of energy for a given process. (3) The amount of substance required for N-fixation per gm.-atom of fixed N. General methods of calculation are given for such processes. The reactions between N_2 and C or hydrocarbons, and between N_2 and CO_2 are shown to be inexpedient for N-fixation, whereas the O_2 method utilises the cheapest raw material and gives directly the most valuable form of fixed N, *viz.* NO. It is concluded that among all the thermal methods of N-fixation considered, the processes using O_2 and CH_4, with NO and HCN as products, appear to be the most promising from the point of view of purely thermodynamic analysis. H. H. Ho.

See also Abstracts 1933, 2053, 2272, 2275, 2276, 2288, 2352.

VAPOUR PRESSURE.

2305. Vapour Pressures and Association of Metallic and Non-Metallic Alkyls. H. W. Thompson and J. W. Linnett. *Faraday Soc., Trans.* 32. *pp.* 681–685, *April*, 1936.—The vapour pressures of a series of metallic and non-metallic alkyls are measured over a range of temperature. The Trouton constants thus calculated indicate that these compounds show little, if any, association. The degree of association of other similar substances is discussed. AUTHORS.

2306. Vaporising Equilibrium of Binary Mixtures of $HgCl_2$ and $HgBr_2$ and of the Reciprocal Pairs of Salts (Na, K) (Cl, Br). H. Hintz and K. Jellinek. *Zeits. f. Elektrochem.* 42. *pp.* 187–200, *April*, 1936.—The transference method of Greiner and Jellinek [see Abstract 4173 (1933)] is used to determine the vapour pressures of $HgCl_2$ and $HgBr_2$ at 238° C. The vapour pressures of mixtures of these liquids are calculated from the partial pressures and found to agree with determinations by the static and dynamic methods. It follows from this that the mixture $HgCl_2$-$HgBr_2$ behaves as a perfect gas and forms no compounds, and proves the molecular formulæ $HgCl_2$ and $HgBr_2$ to be correct. The vapour pressures of the pure salts NaCl, NaBr, KCl, KBr are measured at 1250° C. and found to be in accord with the data of Wartenberg and Albrecht. The binary mixtures NaCl-KCl, KCl-KBr, KBr-NaBr, NaBr-NaCl are examined at 1250° C. and found to behave as ideal solutions. Results are given for the vapour pressures of the reciprocal pairs of salts (Na, K), (Cl, Br) at 1250° C., the corresponding diagram being constructed. R. W. P.

See also Abstracts 1970, 1999, 2047, 2152, 2288.

ACOUSTICS.

2307. Sound. E. G. Richardson. *Phys. Soc., Reports*, 2. *pp.* 166–187, 1935.

2308. Elastic Impact of a Pianoforte Hammer. R. N. Ghosh. *Acoustical Soc. of America, J.* 7. *pp.* 254–260, *April*, 1936.—It is shown in this paper that Heaviside's operational methods can be applied to the problem of impact of a pianoforte hammer on a string. A particular case is treated in which the duration of contact is less than the gravest period of vibration of the string, and a/l is a small fraction. It is found that the resulting displacement of the striking point is the sum of a Kaufmann term and a series of terms which are highly damped. The periods of the terms are approximately $T = 2a/c$, $4a/c$, $6a/c$, etc., when k is small. The pressure between the hammer and the string is shown to rise by jumps continuously from a large negative value to a large positive value when the damping coefficient is large. The presence of damping in the terms is very important and it is on this account that the higher terms vanish and the pressure rises and falls smoothly. The solution in terms of pulses reflected from the nearer extremity is also obtained with the help of Heaviside's operational method, but it is very cumbrous and is of hardly any practical value.

AUTHOR.

2309. Diffraction of Light by H.F. Sound Waves: Part IV. C. V. Raman and N. S. N. Nath. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 119–125, *Feb.*, 1936.—The essential idea that the phenomenon of the diffraction of light by h.f. sound waves depends on the corrugated nature of the transmitted wave-front of light, pointed out by the authors in their first paper, is developed on general considerations in this paper. The results can be summarised as follows:—(1) If progressive sound-waves travel in a rectangular medium normal to two faces and the direction of propagation of a plane beam of incident light, the incident light will be diffracted at the angles given by $\sin^{-1}(-n\lambda/\lambda^*)$ and the light belonging to the nth order will have the frequency $\nu - n\nu^*$. (2) If the sound waves are stationary, the incident light will be diffracted at the angles given by $\sin^{-1}(-n\lambda/\lambda^*)$, an even order would contain radiations with frequencies, $\nu, \nu \pm 2\nu^*, \nu \pm 4\nu^*, \ldots, \nu \pm 2r\nu^*, \ldots$, and an odd order would contain radiations with frequencies $\nu \pm \nu^*, \nu \pm 3\nu^*, \nu \pm 5\nu^*, \ldots, \nu \pm 2r \pm 1\nu^*, \ldots$ (3) A differential-difference equation is obtained for the amplitude function of the diffracted orders whose approximate solution is satisfied by the Bessel functions already obtained by the authors in their previous papers. [For Part III see Abstract 1779 (1936).]

AUTHORS.

2310. Diffraction of Light by Ultrasonic Waves. E. Hiedemann and E. Schreuer. *Zeits. f. Physik*, 99. 5–6. *pp.* 363–368, 1936.—After giving a summary of the main points of Raman and Nath's theory of the diffraction of light by progressive ultrasonic waves [see Abstract 1779 (1936)], the authors, by taking into account the motion of the sound-wave grating, introduce the change of frequency into the diffraction integral. It appears on evaluation of the integral that consideration of the change in frequency makes little change in the grating formula or in the calculated distribution of intensity in the case of a narrow sound field.

G. E. A.

2311. Evidence of Frequency Variation of Light Due to the Doppler Effect in the Diffraction of Light by Supersonic Waves in Fluids. L. Ali. *Helv. Phys. Acta*, 9. 2. *pp.* 63–83, 1936. *In German.*—A full account is given of work previously described in brief [see Abstract 5128 (1935)]. It is shown that in the diffraction of light by progressive supersonic waves the light undergoes the Doppler effect to be expected on theoretical grounds. This effect for the line 2537 Å and the supersonic frequency 7600 kc./s. has the value $1{\cdot}6 \times 10^{-5}$ Å. It is also shown that the diffraction by stationary supersonic waves cannot be regarded as a superposition of the diffractions due to the two progressive waves which make up the stationary wave system. A. W.

2312. Speed of Ultrasonic Waves in Colloidal Solutions. A. Passynski. *Acta Physicochimica*, 3. 6. *pp.* 779–782, 1936. *In German.*—The speed is measured in water, acetone, benzol, ethyl ether and solutions of common salt of various concentrations, and the elastic modulus E is deduced. The speed values found are in agreement with those of previous observers. The speed is then determined for a series of sols of Fe_2O_3, for rubber in benzol, nitrocellulose in acetone and gelatin in water. The general result is that the colloids in solution cause extremely little change in the elastic properties of the solvent. A slight rise in E accompanies the ageing of the sols, and in benzol-rubber solution E diminishes as the concentration increases. G. E. A.

2313. Law of Blackening of Photographic Plates by Ultrasonic Radiation. N. Marinesco. *Comptes Rendus*, 202. *pp.* 757–759, *March* 2, 1936.—Shows that the blackening by ultrasonic waves follows a law very similar to that for plates normally illuminated. The curves of opacity against log t have the same shape in that they have one part representing under-exposure, one indicating correct exposure and one over-exposure, the contrast factor increasing with concentration of developer. Distilled water used as the developer always indicates under-exposure, the reason for this being briefly discussed. [See Abstract 2197 (1935).] R. C. F.

2314. Apparent Duration of Sound Perception and Musical Optimum Reverberation. S. Lifshitz. *Acoustical Soc. of America*, *J.* 7. *pp.* 213–221, *Jan.*, 1936.—In continuation of previous work [see Abstract 3724 (1933)] a circuit is described by which the duration of a sound impulse in a telephone can be regulated from 0·012 sec. upwards. From experiments made with the circuit and otherwise the following are among the conclusions arrived at. The unit of apparent duration of sound is taken as the apparent duration of a constant pure tone which has sounded for 1 sec. at an equivalent loudness of 1 db. The integral law of apparent duration for a constant tone holds true within the limits 2 to 53 units of apparent duration. The law is independent of the frequency. The reverberation optimum equations for concert halls, broadcasting studios and sound moving-picture theatres are given, and are obtained by equating the duration integral to a constant value. The optimum loudness of musical performances at the reverberation optimum for broadcasting studios and sound moving-picture theatres is about 10 db greater than the optimum equivalent loudness for concert halls. G. E. A.

***2315. Small-Scale Measurement of Sound Transmissions. J. S. Rankin.** *Roy. Techn. Coll. Glasgow*, *J.* 3. *pp.* 542–550, *Jan.*, 1936.—A box-like apparatus for testing the sound transmission qualities of panels measuring 3 ft. by 2 ft. is described. Results are given which

compare favourably with those obtained by other observers using special sound-proof rooms and more elaborate apparatus. AUTHOR.

2316. Continuous Clicks. W. Bürck, P. Kotowski and H. Lichte. *Hochfrequenztechn. u. Elektroakustik*, 47. *pp.* 33–37, *Feb.*, 1936.—The authors continue their work on transient noises [see Abstract 5134 (1935)] and study the loudness of the continuous repetition of repeated peaky wave-forms at all frequencies up to 4000 times per sec. The wave-forms of these are analysed and it is shown that it is possible to calculate the apparent loudness, which is measured independently. The experiments confirm the linearity and aperiodicity of the ear for sounds which have a level which is not excessive. L. E. C. H.

2317. Absolute Measurement of Sound Absorption for Oblique Incidence. L. Cremer. *E.N.T.* 13. *pp.* 36–47, *Feb.*, 1936.—For absolute measurements of sound absorption a large flat sheet of the material under investigation was mounted vertically in the open air in the sound field of a 1000-cycle sphere source located 5 m. away and at the required angle of incidence. In the resultant sound field immediately in front of the absorbing surface a pressure gradient receiver could be moved to and fro and also rotated. In this way it was possible, by use of the directional characteristic of the receiver, to cut out first the direct and then the reflected wave train and determine the degree of absorption by comparison of the two receiver readings. It was also found that where the two waves were in phase or in opposite phases, the receiver could be rotated to a zero position, the corresponding angle being a measure of the absorption. Results are given of measurements by both methods. A. W.

2318. Transmission of Sound through Sea Water. Part II. H. G. Dorsey. *Acoustical Soc. of America, J.* 7. *pp.* 287–299, *April*, 1936.—A further account is given of results obtained by the radio-acoustic method of locating the position of a surveying ship [see Abstract 2505 (1932)]. The results obtained since the publication of the first paper show that the hypothesis there advanced as to the propagation of sounds to great distances in sea water is unsound, and that in any body of deep water not having uniform temperature throughout, sound is transmitted to a distant point only by multiple reflections, in agreement with the hypothesis put forward by Service in 1928. Interesting records are given of the reception of bomb signals from one surveying ship steaming directly away from the receiving ship. In the first series, carried out in deep water averaging 2750 m. in depth, the direct wave faded away and was not received beyond 9 km., whereas the first reflected wave was received regularly at distances up to 40 km. In the second series, the depth at the commencement of the run was 1460 m., and 84 m. at the end of the test, the run being made towards the shore, so that the bomb signals passed from shallow to deep water. In this case the first reflected wave faded out at a distance of about 10 km. while the direct wave continued to be received up to the end of the run (24 km.). Transmissions in the reverse direction, from deep to shallow water, were not carried out. Further results of careful observations carried out in a selected area near Santa Cruz confirmed the reflection theory of transmission. A. W.

See also Abstracts 1935, 1986, 2299.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

2319. Structure of a Spark Flashing at the Surface of a Solution. P. Jolibois. *Comptes Rendus*, 202. *pp.* 400–402, *Feb.* 5, 1936.—The spectrum of Cu is obtained by passing a h.v. current between a 10 % solution of $CuSO_4$ and a Pt electrode just above the surface of the solution, which is made the negative pole of the spark discharge. The Cu spectrum is not obtained when the polarity of the solution is reversed. In this condition, the process of electrolysis effected by the discharge comprises the separation of H_2 and the precipitation of hydrated CuO. [**Errata,** *ibid.*, *p.* 704, *Feb.* 24, 1936]. J. S. G. T.

2320. Sliding Sparks. E. Kluss. *Arch. f. Elektrot.* 30. *pp.* 187–199, *March* 10, 1936.—In this investigation it is shown that for spark discharges pressure effects in the surrounding medium occur and in consequence the path of the spark may be shown on the surface of a smoked glass plate. If a ground glass plate has a pencil line drawn on it and after being smoked is subjected to a condenser discharge, the spark follows the pencil line and also spreads on both sides into the smoked layer, giving a spark image. If the pencil line has a right angle bend it is found that within the right angle the pressure effects give rise, through interference, to spark pattern variations whose characteristics give information regarding the velocity of propagation of the pressure along the spark path. A. W.

2321. Effects of Priming Gases on the High-Pressure Mercury Discharge. W. Elenbaas. *Physica*, 3. *pp.* 219–236, *April*, 1936. *In German.*—The increase in energy loss per cm. of a high pressure Hg discharge, when a given percentage of noble gas is added, is determined by measuring the decrease in the radiation output. Curves are given showing the variation with power input of the total light output and the intensity in various parts of the spectrum, with a number of concentrations of He, Ne and A. The increase in energy loss per cm. varies only slightly with the power input per cm. This loss can be calculated as a function of the percentage of priming gas, on the assumption that it is caused by an increase in the heat conductivity due to the lighter noble gas atoms. Using a formula due to Enskog for the heat conductivity of a mixture, these calculations are carried out and found to be in agreement with the experimental results. J. E. R.

2322. Recombination of Ions in Air and Carbon Dioxide at High Pressures. W. Mächler. *Phys. Zeits.* 37. *pp.* 211–213, *March* 15, 1936. —The paper gives the results of the measurements of the re-combination coefficient α in air and CO_2 for pressures up to 25 atmospheres and temperatures 18° and 52° C. It is found that αp is constant in air for pressures greater than 15 atmospheres but decreases in the case of CO_2 after reaching a maximum at 8 atmospheres. In air, α decreases with increase of temperature, but in CO_2 it increases very slightly. The temperature coefficient of the ionisation current produced by γ-rays increases with pressure in the case of CO_2, but in the case of air, the coefficient has a maximum value at about 17 atmospheres and then decreases rapidly. These results are compared with those of other observers. W. E. P.

2323. Effect of Intense Illumination on Time Lag in Static Spark Breakdown. H. J. White. *Phys. Rev.* 49. *pp.* 507–512, *April* 1, 1936.—

The time lag of spark breakdown in static uniform fields and with intense kathode illumination is studied in air, He and CO_2. In air, the time lag is about 10^{-7} sec. for overvoltages of a few % and increases very rapidly with decreasing overvoltage. Increasing the overvoltage to above 30 or 40 % reduces the time lag to $2{\cdot}5 \times 10^{-8}$ sec. (approx.), depending partly on the nature of the initiatory spark. An explanation of the previous observations of the position of the mid-gap streamer is advanced on the basis of space-charge effects. The results in CO_2 are similar to those in air, but in He a much higher overvoltage is found necessary to produce a given time lag. This is attributed to the relative rates of gain of energy by electrons in the two gases. R. L.

***2324. Electron and Ion Densities in a Wall-Free Gas Discharge. A. Sibold.** *Helv. Phys. Acta*, 9. 2. *pp.* 123–160, 1936. *In German.*—Using the Langmuir probe method, measurements are made of the electron and ion densities and the space potentials in the positive column of an arc discharge in N_2 at pressures up to 124 mm. Hg. The ordinary insulated probe used in work on low pressure discharges is unsuitable for these pressures owing to the high gas temperatures. A new form of probe apparatus is described, which overcomes these difficulties; questions of probe size and temperature are discussed in detail. Measurements of the space potential in the positive column show that at pressures below 50–60 mm. Hg the equipotentials are approximately in the plane at right angles to the axis of the discharge, but at higher pressures the surfaces curve towards the anode. The measurements of Wehrli and Bächtiger on the relationship between the slope of the ion characteristic and space potential are confirmed. The current carrying range of the positive column is found considerably to exceed the light zone. At a fixed kathode distance, the electron current increases with increasing arc current over the whole cross-section of the positive column. Along the axis of the discharge both the ion and electron densities increase from anode to kathode, and as the pressure decreases this current gradient is greatly increased near the kathode. In the direction from kathode to anode the ratio of electron to ion density decreases. Current density measurements on glow discharges and arcs show that under corresponding conditions of working current and pressure, the density in the arc is considerably greater. J. E. R.

***2325. New Glow-Discharge Effect. Application to Braun Tube with Low Kathode Potential. W. Krug.** *Arch. f. Elektrot.* 30. *pp.* 157–183, *March* 10, 1936.—An account is given of the investigation of a new type of glow discharge resulting in a well concentrated kathode beam from a cold hollow kathode. In spite of the fact that the beam is somewhat non-uniform in the velocity distribution of its electrons, it has been found practicable to utilise it in the construction of an oscillograph whose power approximates to that for hot-kathode tubes, although only low kathode potentials are employed. A. W.

2326. Velocity Distribution of Electrons in a Magnetic Field. T. V. Ionescu and C. Mihul. *Comptes Rendus*, 202. *pp.* 1160–1162, *March* 30, 1936.—Velocity distribution curves are given for electrons from a tungsten filament accelerated between two grids at various p.d.s. A preliminary discussion is presented. N. M. B.

2327. Velocity-Distribution of Electrons in a Low Pressure Discharge Tube. A. H. van Gorcum. *Physica*, 3. *pp.* 207–218, *April*, 1936. *In English.*—A description is given of a method for the determina-

tion of the second derivative of current-voltage characteristics. The method is applied to the characteristic of a probe inserted in a neon discharge-tube. With the aid of the formula, deduced by Druyvesteyn [see Abstract 600 (1931)], the velocity-distribution of the electrons in the discharge can be determined. This is done at several points in the discharge. The results are shown in a graph, and it can be seen how, approaching the positive column from the kathode-side, the velocity-distribution changes into a Maxwellian one. AUTHOR.

2328. Mean Lifetime of Metastable Neon Atoms. E. W. Pike. *Phys. Rev.* 49. *pp.* 513–515, *April* 1, 1936.—Penning has shown that illumination of the Townsend discharge in neon with red light from an auxiliary neon arc reduces the number of excited atoms in the former. The concentration of excited atoms in the Townsend discharge as a function of illumination intensity can be computed from the electronic properties of neon ; a comparison with Penning's direct measurements evaluates the mean life-times of both the metastable and the resonance states in the gas. The numerical results for 36 mm. pressure are : mean lifetime in sec. of the $^3P_2$ metastable state $= 2 \times 10^{-3}/p$; of the 2^3P_1 resonance state $= 4 \times 10^{-5}/p$, where p is the pressure in mm. Hg. Values for the mean lifetime of the 2^3P_2 state derived by Zemansky's method from absorption measurements at about 3 mm. Hg pressure are : $9 \times 10^{-4}/p$ from Meissner and Graffunder's measurements, and $8 \times 10^{-3}/p$ from Dorgelo and Washington. [See following Abstract.] AUTHOR.

2329. Penning's " New Photo-Effect " in Pure Neon. E. W. Pike. *Phys. Rev.* 49. *pp.* 515–518, *April* 1, 1936.—The maintaining voltage of a Townsend discharge in pure neon is measured as a function of the illumination of the discharge with light from a neon arc, using a more sensitive circuit than that of Penning. In contrast to the Townsend discharge in slightly impure gas, in pure gas it is almost insensitive to illumination over a wide range of pressure, current, tube geometry and kathode material. With progressive cleaning of the gas, the change in maintaining voltage due to illumination passed from a small positive value through zero to a small negative value. The general equations of the discharge are developed, but a complete identification of the active atomic processes is not yet possible. [See preceding Abstract.] AUTHOR.

2330. Mechanism in the Positive Column of a Discharge. L. S. Ornstein, H. Brinkman and T. Hamada. *K. Akad. Amsterdam, Proc.* 39. 3. *pp.* 315–324, and 39. 4. *pp.* 484–485, 1936.—The measurements by Hamada [see Abstract 1795 (1936)] of the temperature T of the gas along the diameter of a narrow tube, containing the positive column of a discharge in nitrogen, are discussed. The importance of the determination of T for the mechanism of a gas-discharge is emphasised. It is shown that the velocity distribution of the electrons, depending on the parameter $E_0 \cdot \lambda$ (E_0 axial field-strength, λ electronic mean free path) varies along the tube-diameter ; this variation is only due to the radial variation of T. For the discharge in nitrogen the fact is reported that $E_0\lambda$ ($= 0{\cdot}066$ V) is independent on the discharge conditions for pressures between 10 and 30 mm. At lower pressures $E_0\lambda$ increases, thus electrons with high energies become more probable. The different shape of the intensity curves over the tube-diameter for N_2 and N_2^+ bands are discussed. It is proved qualitatively that the effect of the increase of the total excitation probability of the N_2 bands with temperature T (due to the excitation from N_2 molecules in higher vibrational

states) must be taken into account in order to explain the experimental facts. In an appendix an elementary deduction of the velocity distribution of electrons in a gas discharge is given. AUTHORS.

2331. Behaviour of Oxygen under Electron Bombardment. N. Nekrassow and I. Stern. *Acta Physicochimica*, 4. 2. *pp.* 283–300, 1936. *In German.*—The disappearance of O_2 from the gas phase in a three electrode valve with and without bombardment by electrons of various velocities from a filament is investigated. It is shown that, independently of the electron energy, the O_2 disappears owing to adsorption in the metal walls of the apparatus, when the latter are heated above 150° C. by the hot filament. It is shown that the rate of decrease of O_2 pressure under electron bombardment depends on the area of the metal walls of the container, thus suggesting that an active form of O_2 produced by electron collisions is absorbed in the walls. The probable rôle of a metastable excited O_2 molecule with excitation energy 1·62 V, and the possible effects of secondary electrons in the formation of active particles in the gas are discussed. J. E. R.

2332. Theoretical Cross-Section for K-Electron Ionisation by Electron Impact. W. W. Wetzel. *Phys. Rev.* 49. *pp.* 531–534, *April* 1, 1936.—Born's approximation is applied to the general problem of single K-shell ionisation without excitation. Slater's wave functions are used and a formula is derived which expresses the cross-section as a function of the atomic number, the ionisation potential of the K-shell and the energy of the colliding electron. By comparison with experimental measurements the theory is shown to give good qualitative results for collision energies above about three times the ionisation energy. AUTHOR.

***2333. Mass-Spectrograph and its Uses. W. Bleakney.** *Am. Phys. Teacher*, 4. *pp.* 12–23, *Feb.*, 1936.—Summary of the properties and applications of mass spectrographs based upon a variety of different principles. F. C. C.

***2334. Minimum Potential for Ozone Formation by Electron Collision. F. Krüger and Charlotte Zickermann.** *Zeits. f. Physik*, 99. 5–6. *pp.* 428–452, 1936.—The formation of O_3 in a tube in which electrons are passed through O_2 is followed by observing the gas pressure changes. Detailed descriptions are given of the apparatus used for producing and measuring the voltage of the electron beam and for gas analysis. The minimum electron potential required for O_3 formation is found to be 6·3 V, considerably lower than the value of 8·9 found by Henry. The discrepancy may be traced to a neglect of contact potentials in Henry's measurements. A discussion of the band spectrum of O_2 leads to a value between 6·09 and 7·05 V for O_3 formation, which occurs only when an O_2 molecule is split up into an excited and a normal atom. In a discussion of previous work on the excitation potentials of O_2 it is suggested that the value between 8 and 9 V obtained by most workers is too high and should be replaced by a value between 6 and 7 V. A value between 6·6 and 7·2 V for the minimum ozone formation potential agrees with the value obtained by the photochemical method using u.v. light. It is observed that the minimum energy required for ozone formation is 1 or 2 V higher than the heat of dissociation of O_2, 5·09 V. This can be explained by the fact that thermal dissociation produces two unexcited O atoms, whereas dissociation by electron impact, which results in the formation of ozone, produces an excited and a normal atom. J. E. R.

***2335. Electrical Properties of the Intermittent Arc. K. Gaulrapp.** *Ann. d. Physik*, 25. 8. *pp.* 705–727, *April*, 1936.—An experimental arrangement is described which enables the sparking arc to be produced between any kind of metallic electrodes in different gases under varying pressures. The currents, voltages and arc-lengths are recorded by means of an oscillograph, a h.f. method being used for the registration of the arc-length. Data are given for the current-voltage characteristics of Zn in air by H_2, whereby it is established that with small pressures and arc-lengths the sparking voltage is independent of current strength and arc-length. The minimum voltages required in the cases of a number of metals for the production of sparking arcs are assembled in a table. Further, the dependence of current densities at the kathodes of C and Zn arcs upon pressure has been determined and the metals classified into three groups according to the appearance of the kathode dust, corresponding to Ramberg's division of metals for continuous and a.c. arcs. Finally, an a.c. arc is described of constant uniform electrical energy and the fact of its reality established. The latter should be suitable as a source of light in quantitative spectrum analysis. H. H. Ho.

***2336. Flexible Attachment for Use in Vacuum Apparatus. H. Lloyd.** *Journ. Sci. Instruments*, 13. *pp.* 117–119, *April*, 1936.—A readily adjustable fitting for a kathode-ray tube is described, permitting a rotation of the kathode in three planes, and translation in one plane. A pair of lenses forms the basis of the design, which has proved satisfactory in use. Attention is drawn to the possibility of its application to other apparatus where it is desired to carry out manipulations through the walls of sealed vessels. AUTHOR.

***2337. Tube-Counter and Coincidence Theory. L. Jánossy.** *Zeits. f. Physik*, 99. 5–6. *pp.* 369–404, 1936.—The exact determination of the directional distribution function $R(s)$ of the penetrating radiation, from tube-counter and coincidence methods requires a solution of a general integral equation $K(p) = \int_s R(s)\ S(s,p)d\omega$. As an example, the determination of the directional distribution of penetrating radiation as found by counters in G-formation is examined. In this way the new counter theory is given practical significance and computing tables to shorten calculation are provided. F. C. C.

***2338. Arrangement for Breaking Thyratron Current. H. Staub.** *Helv. Phys. Acta*, 9. 3. *pp.* 84–86, 1936. *In German.*—In impulse counting apparatus thyratrons are to-day frequently employed, but difficulties have been met with owing to the unsuitability of ordinary relays with metal contacts for breaking the thyratron current after each impulse. A simple arrangement without moving parts is described for cutting off the current in a thyratron used in counting apparatus. The anode potential for the thyratron is furnished by a condenser C of suitable value. For ordinary telephone counters a few microfarads suffice. This condenser is charged from the anode battery through a resistance R. If an impulse from the previous valve makes the grid of the thyratron for an instant positive, current flows in the thyratron and operates the counting mechanism. The thyratron current flows only so long as the potential across C exceeds the ignition potential. The rate of quenching depends on the time constant of the anode circuit RC. For a circuit used the half value time was about 1/30 sec. By connecting the primary of a transformer in parallel or in series with the coil operating the counting mechanism and the secondary of the transformer in the grid circuit of an additional

valve, a loud speaker can readily be operated so as to give audible records of each impulse. A. W.

See also Abstracts 2133, 2203, 2250, 2267, 2456.

CONDUCTION IN SOLIDS AND LIQUIDS.

2339. Electrophysics of Solid Bodies. A. Smekal. *Die Physik*, 4. 1. *pp.* 17–33, 1936.—A critical and historical review of papers dealing with conductivity in solids which have appeared from 1927 to the end of 1935, under the following headings:—1. Lattice structure. 2. Surfaces and structural imperfections in crystals. 3. Glasses. 4. Ionic conduction in general. 5. Dependence of ionic conduction on temperature. 6. Dependence of transport properties on temperature. 7. Mechanism of ionic conduction. 8. Ionic conduction and chemical constitution. D. R. H.

2340. Mechanism of Electrical Conduction in Solids. A. Smekal. *Phys. Zeits.* 37. *pp.* 150–153, *March* 1, 1936.—Conductivity is the sum of two fundamentally different components, lattice conductivity and ionic transfer. The latter, which is affected by structure, is generally assumed to take place *via* interstitial spaces, accompanied by little distortion of the lattice, and may be demonstrated by the ultra-microscope. For halides of Na and K, anions and kations are about equally responsible for lattice conduction, in AgBr and AgCl kations alone are responsible so that the special unidirectional conductivity of these substances can be explained without further assumptions. For AgI, interstitial conduction becomes marked, on account of the wide lattice. If ionic conductivity at low temperature were really dependent on previous thermal history, a drop would occur on long continued electrolysis. Further, materials with symmetrical lattice conductivity would possess also symmetrical ionic conductivity, whereas at low temperatures both NaCl and KCl definitely show unsymmetrical ionic conduction. In rock-salt the presence of a lattice component of conductivity, affected by structure and independent of impurities, may be shown. After heat treatment at 600° C., cooling to 138° C., and electrolysis for 40–100 hr., an irreversible drop of conductivity as high as 30 % sets in. Numerous observations on the effect of duration and temperature of heat treatment are compatible with the existence and gradual destruction of a lattice factor in the low temperature zone. During long continued electrolysis the unalterable ionic component should set up a constant back-voltage, while the portion vanishing gradually on subsequent heat-treatment would be confirmed as a lattice component. A continuous passage from a closely packed lattice to a "gap lattice" (already known for Al_2O_3 and Fe_2O_3) is possible without difficulty from a theoretical stoichiometric standpoint. D. R. H.

***2341. Electrical and Magnetic Measurements. L. Hartshorn.** *Phys. Soc., Reports*, 2. *pp.* 221–246, 1935.

***2342. Physical Voltage-Regulating Devices. P. J. Higgs.** *Journ. Sci. Instruments*, 13. *pp.* 114–117, *April*, 1936.—The object is to regulate the voltage across the filament of a thermionic valve to 0·1 % under conditions where the supply voltage may vary ± 10 %. Three methods of regulation are tried, viz. barretters, a bridge, and a barretter and bridge in series. The results indicate that the regulation provided by a barretter is relatively coarse, by a bridge is fairly fine, and by the barretter and bridge in series is fine and well within the required limits. The efficiencies of the methods decrease with increase in the closeness of the regulation obtained. AUTHOR.

2343. Force Between Two Coaxial Single Layer Helices Carrying Current. R. T. Glazebrook and H. M. Lyon. *Roy. Soc., Proc.* 154*A*. *pp.* 1–3, *March* 2, 1936.—In the measurement of a current by means of a balance an expression is required for the force in terms of the dimensions of the coils of the balance, which usually take the form of single layer helices. Jones's formula gives a very simple method of calculating this force, but it assumes that the magnetic field produced is axially symmetric, and neglects the spiral nature of the fixed coil. A formula for the force between two coaxial helical conductors is here given. If the force is calculated for several positions obtained by rotating the suspended coil through different angles relative to the fixed coil, the mean correction for spirality is zero, so that Jones's method can be used. A. J. McC.

***2344. Absolute Determination of the Ampere. G. H. Briggs.** *Journ. Sci. Instruments*, 13. *pp.* 127–129, *April*, 1936.—It is shown that it should be possible to exceed the accuracy of the current balance methods of determining the ampere in absolute units by measuring the field of a large permanent magnet by both the magnetic balance and the search coil methods. AUTHOR.

***2345. Continuous-Reading Thermionic Conductance Meter. R. L. Garman.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 146–147, *March* 15, 1936.—A thermionic conductance meter deriving power from a.c. or d.c. mains combining an audio oscillator-bridge and a detector-meter system is described. The application to conductometric titrations is illustrated and it is shown that meter readings are linear with resistance over four-fifths of the meter range. AUTHOR.

2346. Abnormal Electrical Conductivity in Powdered Tellurium. C. H. Cartwright. *Phys. Rev.* 49. *pp.* 443–448, *March* 15, 1936.—A detailed investigation of the effect of pressure on the electrical conductivity of Te powder is reported. Under a pressure of 1000 kg./cm.^{2} it had about 10 times greater electrical conductivity than that of a single crystal under the same conditions. At 20,000 kg./cm.^{2} massive Te increases its conductivity more than 100 times and the rate of increase rises rapidly with pressure. It is suggested that the behaviour may be due to local pressures between particles of the powder, but this does not entirely account for the magnitude of the anomalous conductivity. The assumptions that appear necessary are given. R. L.

2347. Destruction of Adsorbed Barrier-Layer by Pressure. F. Trey. *Phys. Zeits.* 37. *pp.* 213–214, *March* 15, 1936.—The rectifying action of PbS-tablets may be diminished by the application of pressure to the surface. A reduction of 10 % in unipolarity is perceptible under a pressure of 500 kg./cm^2. For pressures in excess of 4000 kg./cm.^{2} unipolarity has fallen to 10 % of its normal value. T. I. J.

2348. Electrical Behaviour of Cuprite Crystals. P. Brauer. *Ann. d. Physik*, 25. 7. *pp.* 609–624, *April*, 1936.—It is shown that the electrical resistance and the Hall constant increase with the pressure of the surrounding atmosphere. The water vapour alone appears to be responsible for this and the conductivity is found to vary in a peculiar way with the moisture content of the surrounding air. The measurements of Hall effect indicate the relation between the change of conductivity and the electron concentration. It is also shown that this is a surface effect and suggested that perhaps a surface conductivity exists. The change of electron concentration at the surface on wetting is calculated and a possible explanation is briefly suggested. Various further experiments are

described together with details of apparatus employed, and finally the influence on the effect of the variation of the temperature between 20° and 70° C. is studied. R. L.

2349. Magnetic Effects and Current Sensitivity of Supraconducting Films. A. D. Misener. *Canad. J. of Research*, 14. *Sect.A. pp.* 25–37, *Feb.*, 1936.—The work described in this paper is a continuation of the investigation of the anomalous behaviour of supraconducting metals in the form of thin films ($12 \cdot 2$–$0 \cdot 3\mu$). The manner in which an external magnetic field will penetrate when applied to supraconducting films of various thicknesses at a variety of temperatures below their transition points is studied. It is found that there is a critical field that will penetrate the film, and that this field is less than the threshold field required to restore the resistance of the film at the same temperature. Even for fields much larger than the threshold field, the films act as partial magnetic shields and diminish the field strength by an almost constant amount. By measuring the current required to restore the resistance of films formed on cylindrical supports of different diameters, it is shown that their current sensitivity is due to a surface density of current. The critical magnetic field associated with this threshold current is less than either the threshold field (external) or the critical field for penetration. The similarity between these effects and those found for certain supraconducting alloys is discussed. AUTHOR.

2350. Magnetic Properties of Supraconductors. T. C. Keeley and K. Mendelssohn. *Roy. Soc., Proc.* 154*A*. *pp.* 378–385, *April* 1, 1936.—Since the "freezing in" of lines of force in a spherical supraconductor observed by Mendelssohn and Babbitt [see Abstract 4405 (1935)] might be explained by the fact that the magnetic field inside a hollow sphere becomes inhomogeneous when the body becomes supraconducting, this cause of inhomogeneity is now avoided by using long shaped specimens. The effect is still observed, and for pure metals the proportion of lines of magnetic force which are "frozen in" when the metal becomes supraconducting varies from zero in Hg to 15 % in Pb. There would be less likelihood of impurities in Hg. 1 % of Bi added to the Pb gave a "freezing in" of 40 % to 80 %, while with 10 % Bi the "freezing in" was complete. To explain the effect a sponge structure is assumed, in which, as the field is decreased, small regions become supraconducting before the bulk of the material. R. W. P.

2351. New Phenomena of Supraconductivity. K. K. Darrow. *Rev. Sci. Instruments*, 7. *pp.* 124–132, *March*, 1936.—Brief review of some of the recent researches on supraconductivity, with special reference to work on the influence of magnetic fields on supraconductors. The investigations of Meissner, Mendelssohn, Simon and their collaborators, in particular, are discussed. C. J. B. C.

2352. Electrical Conductivity and Phase Diagram of Na-Tl Alloys. G. Grube and A. Schmidt. *Zeits. f. Elektrochem.* 42. *pp.* 201–209, *April*, 1936.—The complete range of alloys of Na and Tl is investigated in an atmosphere of an inert gas by the methods of thermal analysis and determination of the dependence of electrical conductivity of the solids upon temperature. The results are incorporated in a complete phase diagram for the system. The intermetallic compounds $NaTl_2$, NaTl, Na_2Tl and Na_6Tl are shown to exist. Of these NaTl melts without decomposition at 305° C. and forms γ mixed crystals with both components. At the Tl end of the concentration range there is a wide region of formation of β and α mixed crystals, while at the sodium end there is a narrow region of

δ mixed crystals. The phase $NaTl_2$ is formed from α and γ mixed crystals by reaction in the solid state at 154° C. The species Na_2Tl is formed from γ mixed crystals and melt at 154° C.; Na_6Tl from Na_2Tl and melt at 77·4°C. The alloys in the concentration range 17 to 24 atomic % of Na are observed to show an increase of hardness on being kept at room-temperature after having been quenched from 200° C. L. A. W.

2353. Theory of Electrical Conductivity and Diffusion in Crystals. W. Jost and G. Nehlep. *Zeits. f. phys. Chem.* 32. *Abt.B.* 1. *pp.* 1–21, 1936.—The threshold energy and the order of energy uncertainty are calculated from thermodynamic considerations. The influence of pressure on electrolytic conductivity is measured by means of the magnitude of the threshold energy, and the influence of the force of collision on the threshold energy. F. J. B.

2354. Electrical Conductivity and the Unit Cell in Silver Bromide. C. Wagner and J. Beyer. *Zeits. f. phys. Chem.* 32. *Abt.B.* 2. *pp.* 113–116, 1936.—According to Schottky's theory of mixed conduction attributable equally to anions and kations, the number of ions per unit cell will diminish as temperature rises; according to Frenkel's theory of ionic migration *via* interstitial spaces with the production of gaps, it should remain unaffected by temperature changes. In borderline cases these theories may be tested, since the number of molecules per unit cell may be calculated from density and lattice constant. For AgBr $\Delta = 6{\cdot}478$ gm./cm.^{3}, $a = 5{\cdot}768 - 5{\cdot}755 \times 10^{-8}$ cm. Hence $\nu = 4{\cdot}010 - 3{\cdot}985$ molecules per unit cell, in good agreement with the rock-salt lattice. The density redetermined at 20° C. was 6·476, in good agreement with the previously found value, and at 410° C. 6·049. By Debye and Scherrer's method a ratio was found of 1·0214 between the lattice constants at 397° C. and at 20° C., the value at 410° C. being vitiated by marked recrystallisation. Hence (ν at 410°C./ν at 20°C.) $> 0{\cdot}995$, unity within the limit of experimental error of 1%, confirming Frenkel's hypothesis. D. R. H.

2355. Decomposition Potential and Conductivity of Mixed Aluminium and Potassium Bromides in Mixed Solvents. W. A. Plotnikow, O. K. Kudra, J. F. Mejenny. *Zeits. f. phys. Chem.* 176. *Abt.A.* 2. *pp.* 154–159, 1936.—While electrolysis of a KBr-$AlBr_3$ mixture dissolved in benzene, toluene and ethyl bromide yields Al at the kathode, addition of nitrobenzene gives on electrolysis a grey K deposit, inflammable in air. The molar ratio $AlBr_3$/KBr is maintained at 5, the nitrobenzene content varying from 0 % to 100 %, giving saturated or almost saturated solutions. The necessary precautions are taken to exclude water and impurities. Additions of small quantities of $C_6H_5{\cdot}NO_2$ to the ethylbromide solution cause a rapid rise in decomposition potential continuously from 1·95 V to 4·38 V and further additions have little effect. At high percentages of nitrobenzene results are vitiated by Br liberation and gumming. Measurements with constant quantities of KBr, $AlBr_3$ and $C_2H_5{\cdot}Br$, show a conductivity maximum in dilute solutions, and a minimum in concentrated solutions, for an equimolar ratio $C_6H_5{\cdot}NO_2$/$AlBr_3$. Within certain limits of $C_6H_5{\cdot}NO_2$ additions, crystals separate, which re-dissolve on increasing the $C_6H_5{\cdot}NO_2$ content. KBr dissolves in $C_2H_5{\cdot}Br$ only in the presence of $AlBr_3$, the conductivity rising sharply at the same time. To explain these results the formation of an $AlBr_3$-KBr-$C_6H_5{\cdot}NO_2$ complex is assumed. By separating anolyte and katholyte by means of a porous diaphragm and using an Al anode, a yield as high as 40 % K is obtained. D. R. H.

2356. Temperature Coefficient of Conductivity of Non-Aqueous Solutions. A. S. Coolidge and H. E. Bent. *Am. Chem. Soc., J.* 58. *pp.* 505–506, *March,* 1936.—The negative temperature coefficient for the conductance of sodium triphenylboron and disodium tri-α-naphthylboron is discussed. The rôle of the solvent in determining ΔH and ΔS is emphasised. The entropy of ionisation of sodium tri-phenylboron is estimated to be −60 entropy units. AUTHORS.

2357. Conductance of Mixed Electrolytes in Ethylene Chloride. Tetrabutyl- and Tetramethyl-Ammonium Picrates. D. J. Mead with R. M. Fuoss and C. A. Kraus. *Faraday Soc., Trans.* 32. *pp.* 594–606, *April,* 1936.—An improved technique for determining conductance of solutions in volatile solvents is described. Relative values, self-consistent to several hundredths of 1 % are obtained. The conductances of tetrabutylammonium picrate, of tetramethyl-ammonium picrate and of various mixtures of these salts in ethylene chloride are determined. Up to about 10^{-4} *N*, conductance values for the mixtures, calculated from the constants Λ_0 and *K* of the pure salts by an extension of the association theory to mixtures, agree with the observed values within the experimental error of about 0·1 %. AUTHORS.

2358. Conductivity of a Freshly Broken Glass Surface. S. Geddes. *Roy. Techn. Coll. Glasgow, J.* 3. *pp.* 551–558, *Jan.,* 1936.—Experiments are described which show that the electrical resistance of the edge of a glass plate is greatly reduced if a strip be cut from the plate by means of a diamond. The fresh glass surface at once attracts to itself a layer of impure water from the atmosphere. Experiments were performed (i) in an ordinary atmosphere, (ii) in an enclosed atmosphere with humidity controlled by sulphuric acid solutions and measured by a hair hygrometer, (iii) in a high vacuum, dry air and clean water vapour. The results obtained are compared with those previously found for a freshly split mica surface and it is concluded that the surface layers in the two cases are practically of the same thickness and that they are formed in the same way, the conductivity being due to condensed matter from the atmosphere rather than to matter dissolved from the solid surfaces. AUTHOR.

See also Abstracts 1942, 1979, 2190, 2276, 2279, 2359, 2369, 2382, 2427, 2448, 2450.

DIELECTRICS AND CAPACITANCE.

2359. Calculation of Various Physical Constants of Heterogeneous Substances. Part II. Dielectric Constants and Conductivity of Polycrystalline and Irregular Systems. D. A. G. Bruggeman. *Ann. d. Physik,* 25. 7. *pp.* 645–672, *April,* 1936.—In this mathematical paper the theory of the dielectric constant and the conductivity of mixed bodies is expanded from isotropic (amorphous or irregular) substances to the irregular systems where the polycrystals of a single pure substance exhibit the character of a mixed body. The accuracy of the old formulæ of Voigt and Andrade-Chalmers are studied and new formulæ are derived for polycrystalline and mixed bodies of different structures and these tested by the existing empirical data. These tests give a satisfactory confirmation of the new theory and reconcile previous conflicting results. [For Part I see Abstract 833 (1936).] R. L.

2360. R.F. Dielectric Constant of Air. L. G. Hector and H. L. Schultz. *Physics,* 7. *pp.* 133–136, *April,* 1936.—The heterodyne beat-frequency method of determining dielectric constants is applied to the measurement of the dielectric constant of air with an applied frequency of

field of 900,000 ~. Radio broadcast signals, stripped of modulation, are used as sources of a.c. of constant high frequency. An electron-coupled oscillator is used in the circuit containing the test condenser. Both h.f. sources are isolated from the detector through buffer stages of amplification. Determination of the beat frequencies is made by photographic recording with a two-string oscillograph. A dielectric constant of $1 \cdot 00058986 \pm 0 \cdot 00000050$ is found for air at normal pressure and temperature. This result is in close agreement with the results of other investigators for lower frequencies of applied field and for static measurements. AUTHORS.

*2361. **Self-Registering Apparatus for Dielectric Constants for Very Short Wave-Lengths. R. Freymann.** *Comptes Rendus*, 202. *pp.* 952–954, *March* 16, 1936.—Details of the self-registering apparatus are given. The dielectric constants of aniline, *mono-* and *di-*methylaniline, *o-* and *m-*toluidine, and pyrrol are measured at three different wave-lengths and consistent results obtained. W. R. A.

2362. **Absolute Value of the C-H Moment and the Sign of the Charge of the Hydrogen Atom in Carbon Compounds. H. G. Trieschmann.** *Zeits. f. phys. Chem.* 32. *Abt.B.* 1. *pp.* 22–26, 1936.—Approximate values are calculated for the partial moments of C-H and C-Cl combinations. The values are obtained from the measurements of interference distances in combination dipole moments. The results render it probable that the H atom in the C-H combination must be considered negative. F. J. B.

2363. **Polarisation of Liquids and their Saturated Vapours in the Critical Temperature Region. J. Marsden and O. Maass.** *Canad. J. of Research*, 14. *Sect. B. pp.* 90–95, *March*, 1936.—The values of the so-called polarisation of methyl ether (liquid and saturated vapour) and propylene (liquid and saturated vapour), from room-temperature to the critical temperature, are given. In both liquids this polarisation is independent of the temperature to within a few degrees of the critical temperature. Calculations show that the polarisations of a liquid and its saturated vapour may be equal above the critical temperature, even though the dielectric constants of the liquid and its saturated vapour, as well as their densities, are different. AUTHORS.

2364. **Molecular Polarisations and Polar Moments of Electrolytes in Benzene Solutions. J. A. Geddes and C. A. Kraus.** *Faraday Soc., Trans.* 32. *pp.* 585–593, *April*, 1936.—The dielectric constant of solutions of a number of salts in benzene is measured at low concentrations and polarisation values, as well as polar moments are computed therefrom. High values obtained for polar moments, ranging from 7 D to 20 D, indicate the existence of electrical dipoles in these solutions. According to the form of their polarisation curves, the electrolytes fall into three groups, namely : (1) in which polarisation diminishes linearly with concentration ; (2) in which a large and non-linear decrease occurs ; and (3) in which the polarisation is independent of concentration. The form of the polarisation curves is related to the structure of the ions of the dipoles concerned, and is determined by association of dipoles to more complex structures. The results of the present measurements are in accord with freezing-point and conductance measurements in the same solvent. AUTHORS.

2365. **Magnetic Variation of the Dielectric Constant of Liquids. A. Piékara and M. Schérer.** *Comptes Rendus*, 202. *pp.* 1159–1160, *March* 30, 1936.—Owing to condenser deformation in the experimental

procedure, results previously announced [see Abstract 4368 (1935)] are erroneous. Data from an investigation with improved technique are given. N. M. B.

See also Abstracts 1959, 2036, 2056, 2190, 2341.

ELECTROCHEMISTRY.

2366. Anodic Behaviour of Organic Copper Salts. G. Kravtzoff. *Comptes Rendus*, 202. *pp.* 1036–1037, *March* 23, 1936.—To determine the effect of variations in c.d., concentration of electrolyte, and time on the electrolysis of solutions of $CuSO_4$ and of cupric formate, acetate and propionate the value of R, the ratio of apparent loss of weight of the Cu anode to the weight of Cu deposited in a voltameter, is measured. If $R < 1$ it indicates that some Cu_2O due to hydrolysis is deposited on the anode. R increases with increased c.d. and (except for formate with c.d. 100 m./dm.^{2}) decreased concentration. It decreases with increasing duration of electrolysis. It decreases in the order formate, acetate, propionate. [See Abstract 461 (1935).] C. A. S.

2367. Ionic Activities of KCl and NaCl. Z. Szabó. *Zeits. f. phys. Chem.* 176. *Abt.A.* 2. *pp.* 125–130, 1936.—It is pointed out that Hermans [see Abstract 1843 (1936)], by taking account of interionic forces, arrives theoretically at an expression for the diffusion potential which yields the same values as the author's empirical equation for HCl in the range 0·0005 to 0·02 mol. Hermans' equation is regarded as a theoretical confirmation of the author's empirical relationship. The experimental investigations are extended to KCl and NaCl in cells of the type Hg | HgCl, NaCl (m_1) | NaCl (m_2), HgCl | Hg and analogous results to those for HCl are obtained. It is concluded that the diffusion potential ϵ is a linear function of the logarithm of the concentration in each case (for KCl up to 1 mol. $\epsilon = 1{\cdot}04 \log m_1/m_2$; for NaCl up to 0·5 mol. $\epsilon = 12{\cdot}31 \log m_1/m_2$) and that in each case the ionic activities can be taken as equal. [See following Abstract.] L. A. W.

2368. Diffusion Potentials and Ionic Activities. J. J. Hermans. *Zeits. f. phys. Chem.* 176. *Abt.A.* 2. *pp.* 131–132, 1936.—Commenting on a publication by Z. Szabó [see preceding Abstract] it is noted that the agreement at low concentrations between the author's theoretical expression for the diffusion potential and Szabó's empirical relation does not justify the extrapolation of the latter to higher concentrations and that the ionic activities deduced from such extrapolation are of doubtful value. A method is suggested which might make possible the experimental determination of diffusion potentials for higher concentrations without reference to ionic activities. This would involve the use of concentrated KCl solutions in cells of the type Hg | HgCl, KCl | solution 1 | solution 2 | KCl, HgCl | Hg. Increasing the KCl concentration would reduce the p.d. between the KCl and the solutions 1 and 2 and extrapolation would then give the desired p.d. between solutions 1 and 2. L. A. W.

***2369. Thermionic Titrimeter without Batteries. H. H. Willard and O. B. Hager, Jr.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 144–145, *March* 15, 1936.—A simple thermionic voltmeter without batteries is described which operates from the a.c. lighting circuit, and is particularly convenient for potentiometric titrations. It is sensitive to 3 or 4 mV and the grid current, which is usually not over 0·1 μA, has no effect on the titration cell. Authors.

See also Abstracts 2192, 2248, 2345, 2380.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

2370. Structure of Electron and Positron. U. Kakinuma. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 618. *pp.* 249–270, *Feb.*, 1936. *In English.*—The author gives a complete account of his unified field theory of the electron and positron. Use is made of a modified form for the Lorentz force and of a theory of gauge-invariance [see Abstract 1752 (1933)]. G. C. McV.

2371. Interaction of Protons and Neutrons. G. Wataghin. *Comptes Rendus*, 202. *pp.* 833–834, *March* 9, 1936.—Discusses the interaction of protons and neutrons in the light of the wave-equations for these particles recently given by the author [see Abstract 3999 (1935)]. It is pointed out how these equations can be modified to yield a difference of mass between the proton and the neutron. W. S. S.

2372. Polarisation Effects in the Positron Theory. W. Pauli and M. E. Rose. *Phys. Rev.* 49. *pp.* 462–465, *March* 15, 1936.—A simple method of obtaining the induced charge-density four vector on the basis of the subtraction formalism of the positron theory is given. Further, in the general case of time-dependent fields the result is calculated directly without use of the Lorentz invariance of the theory. [See Abstract 3665 (1935).] Authors.

2373. Positron Theory and Proper Energies. R. Serber. *Phys. Rev.* 49. *pp.* 545–550, *April* 1, 1936.—The origin of the infinite light-quantum proper energy which follows, according to Heisenberg, from the creation of matter by the field of the photon, is examined in some detail. The inconsistencies which appear on the incorporation of the Dirac positron theory into the formalism of the quantum theory are investigated. These inconsistencies make it impossible to regard with confidence any predictions of the theory for which a consideration of the singularities of the density matrix is essential. It is shown that when the off-diagonal distance in the density matrix is taken different from zero, the proper energy of a light quantum and the electromagnetic energy of an electron are, in order e^2, finite, and that the off-diagonal distance plays in these calculations the part of a generalised electron radius. [See Abstract 2179 (1934).] Author.

2374. Charge of the Electron. H. R. Robinson. *Phys. Soc., Reports*, 2. *pp.* 247–257, 1935.

2375. Individual Effects in Ionic Collisions with Resonance Excitation. F. Wolf. *Ann. d. Physik*, 25. 8. *pp.* 737–756, *April*, 1936. —Previous work [see Abstract 1851 (1936)] is amplified by a qualitative study of the general orientation of the individual particles in its effect on the effective diameter in ionic collisions. An earlier method for measuring the discharge diameters is improved and the diameters for the collision processes He^+, H_2^+ and $H^+ \rightarrow A$ and $H_2^+ \rightarrow Ne$ are again determined for potentials from 30 to 1030 V. The results previously found are verified, but some additional information is obtained. A comparison of the discharge diameter with the effective diameter shows that, in the case $H_2^+ \rightarrow A$, no dissociation occurs, but that in $H_2^+ \rightarrow Ne$, strong dissociation of the H_2^+ ions take place (the discharge diameter in this collision process is extremely small at all velocities). H. J. H. S.

2376. Impact of Slow Electrons in Oxygen. Electronic Affinity. L. Goldstein. *Comptes Rendus*, 202. *pp.* 924–926, *March* 16, 1936.—It has been suggested that the molecules of O_2 and of other electronegative

elements have a strong affinity for electrons, and, in particular, for slow electrons. It is shown, however, that if the apparatus and the O_2 are highly purified and dried and the O_2 is bombarded by a beam of slow electrons in the energy range 0·1–5·9 volts, the gas behaves towards these electrons in a manner analogous to that of the highly purified rare gases; *i.e.* the capture of electrons by the normal atoms of the gas is practically zero. As a precaution against electronegative impurities the gas is activated by electrons accelerated by a potential well below the ionisation energy of the O_2 molecule. For electron energies greater than 5·9 volts the diminution of the number of free electrons is attributed to the effect of O_3 formed by dissociation and constituting a strongly electronegative impurity. N. M. B.

2377. Diffraction of Slow Electrons by Zinc Crystals. S. G. Kalaschnikow and I. A. Jakowlew. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 13–26, 1936. *In German.*—The diffraction of slow electrons by Zn crystals is examined by the method of constant angle deflection. Variation of the normal velocity component from 5·5 to 130 V gave 8 maxima. The equivalent internal potential of Zn is found to be an asymptotically increasing function of the order of reflection with a limiting value of about 27 V. The effect of temperature on the diffraction pattern is examined quantitatively and the results are compared with those predicted by Debye's theory of X-ray scattering. F. C. C.

2378. Internal Potentials of Crystals by Electron Diffraction. S. Kalaschnikow. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 81–88, 1936. *In German.*—The Bragg formula for electron diffraction is modified to take account of phase changes introduced on reflection at the lattice planes. The results lead asymptotically to an equivalent internal potential which is directly connected with the order of reflection. A simple physical interpretation of this equivalent potential is given, and it is found to coincide with the mean lattice potential. F. C. C.

***2379. Electron Tubes. Edited by G. I. Finch. Part I. General Introduction. G. I. Finch. Part II. High-Speed Kathode-Ray Oscillograph. J. L. Miller and J. E. L. Robinson. Part III. Electron Microscope. H. J. H. Starks. Part IV. Electron-Diffraction Camera. G. I. Finch.** *Phys. Soc., Reports*, 2. *pp.* 258–300, 1935.

See also Abstracts 1917, 1943, 1944, 1945, 2057, 2325, 2326, 2336, 2397, 2442, 2457, 2458, 2459.

ELECTROSTATICS.

***2380. Contact Potential between Liquid Amalgams and Mercury in Vacuo. Part I. O. Chaltikian and M. Proskurnin.** *Acta Physicochimica*, 4. 2. *pp.* 263–274, 1936. *In German.*—The method employed utilises a special form of diode in which a Hg or amalgam jet respectively serves as anode. The characteristic curves relating current strength and anode potential for Hg and Na amalgam are found, and from the displacement of these the contact potential is determined graphically. Great care is taken to ensure the accuracy of the results. The contact p.d. concentration curve is found to be similar to an adsorption isotherm in that the contact potential of the amalgam with a Na content between 0·025 and 0·09 % changes very little, and is $1·1 \pm 0·1$ V. R. L.

***2381. Electrostatic Motor. P. Jolivet.** *Comptes Rendus*, 202. *pp.* 1030–1032, *March* 23, 1936.—A modified electrostatic motor is described

in which special arrangements are made for defining the potential on the armature. The motor has an efficiency of 26 %. J. E. R. C.

2382. Measurement of Potential of a Belt-Actuated van der Graaf Electrostatic Generator. M. Feldenkrais. *Comptes Rendus*, 202. *pp.* 1034–1035, *March* 23, 1936.—The charge being conveyed by the belt from the potential of the earth to that of the collecting sphere, measurement of the potential of the latter is based on the difference in the power required to drive the belt when charged and when uncharged, and of the difference in the current passing from the sphere when the belt is in motion and when stationary. [See Abstract 1859 (1936).] C. A. S.

See also Abstract 2461.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2383. Hall Effect in Nickel near the Curie Point. I. K. Kikoin. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 1–12, 1936. *In German.*—The temperature dependence of the Hall effect in Ni up to the Curie point is studied. Simultaneous measurements of the magnetistation of the same sample enabled a determination of the " true " Hall coefficient R_1 to be made. The absolute magnitude and the temperature variation of R_1 are given. Comparison of R_1 above and below the Curie point shows that R_1 at the Curie point does not change appreciably. A possible explanation of the phenonema is given. R. L.

2384. Thermomagnetic Study of Aqueous Solutions of Salts of Rare Earth Metals. G. Dupouy. *Comptes Rendus*, 202. *pp.* 646–648, *Feb.* 24, 1936.—For the temperatures used, solutions of salts of Pr, Nd, Sm, Eu, and Gd obey Weiss' law. W. R. A.

See also Abstracts 2348, 2349, 2350.

MAGNETISM AND ELECTROMAGNETISM.

2385. Anti-Ferromagnetic Interchange Problem at Low Temperatures. L. Hulthèn. *K. Akad. Amsterdam, Proc.* 39. 2. *pp.* 190–200, 1936. *In German.*—If the so-called interchange integral which describes the interchange between adjoining atoms is negative then according to Heisenberg and Bloch ferromagnetism occurs. Cases where interchange action occurs, but with a positive coefficient, are indicated as anti-ferromagnetic. This provides a possible model for magnetic crystals which remain paramagnetic at the lowest temperatures. The behaviour of such models is investigated mathematically at low temperatures with the help of a method given by Heller and Kramers [see Abstract 4718 (1934)]. It is shown that the entropy, without a magnetic field, varies with T^3 and the susceptibility depends on T^2. The quantisation of the oscillation gives agreement with the result of Bloch and Moller. R. S. R.

2386. Internal Energy of Ferromagnetics. E. C. Stoner. *Roy. Soc., Phil. Trans.* 235*A*. *pp.* 165–193, *Feb.* 15, 1936. Experimental data on intrinsic magnetisation—its variation with temperature and field, the magnetic specific heat and the magneto-caloric effect are analysed with a view to studying the dependence of the internal energy of ferromagnetics on intrinsic magnetisation and temperature. Estimates of the formal specific molecular field coefficient $N\rho$ for ferro-magnetics differ widely, not only for different temperatures but also for the same temperature when derived from different sets of experimental data. A detailed examination

is made of the experimental results for the magnetisation, magneto-caloric effect and the specific heat of Ni and values corresponding to $N\rho$ are derived. From the magnetisation and magneto-caloric effect data, the value increases with temperature and, up to about 370° C., with field. The specific heat values indicate a higher value for $N\rho$. It is shown that the extrapolated σ, T (σ = specific magnetisation) curve for H = O has a definite tailing off in the Curie point region and that the specific heat has a maximum at a temperature agreeing closely with that deduced from the magnetisation data. An interpretation is given of the *terme inconnu* of Lapp and Weiss. The discrepancies in the magnetisation and magneto-caloric effect and the specific heat results for $N\rho$ may be overcome if it is assumed that a small fraction of the material consists of small domains containing 10^3 to 10^4 atoms; this interpretation allows for the variability in the behaviour of different specimens and is consistent with Kapitza's results in high fields. The results as a whole are consistent with a value of $N\rho$ for Ni, not varying appreciably with σ, of about $11{\cdot}7 \times 10^4$ above 500° C., not less than $9{\cdot}5 \times 10^4$ at 350° C., and not less than $7{\cdot}4 \times 10^4$ at room-temperature. H. J. H. S.

2387. Theory of Anomalies of Volume of Ferromagnetics. L. Néel. *Comptes Rendus*, 202. *pp.* 742–744, *March* 2, 1936.—Magnetic actions are represented by the energy of interaction between neighbouring atoms. The theory is confined to the case of interaction between any one atom and its $2p$ nearest neighbours. The relative volume anomaly is expressed by $\delta v/v = 3\sigma^2 (\lambda + \mu T + \nu T^2 + \cdots)$, where σ is the spontaneous magnetisation, T the temperature and λ, μ, ν coefficients of which the values of the first two are expressed. The anomalies of expansion may be deduced from the given equation: it may be shown, for example, that there is a discontinuity in the coefficient of expansion at the Curie point. The equation is identical with the empirical equation found by Chévenard for the volume anomalies of ferromagnetics. [See Abstract 1830 (1921).] G. E. A.

2388. Ferromagnetism of Nickel. J. C. Slater. *Phys. Rev.* 49. *pp.* 537–545, *April* 1, 1936.—By using metallic energy levels extrapolated from Cu to Ni, the energy difference between a nonmagnetic and a ferromagnetic state with permanent magnetic moment is calculated for Ni, and it is shown that the ferromagnetic state is the stable one. Both saturation magnetic moment and Curie point are calculated, in agreement with experiment within the limits of error of the calculation. Extrapolation further into the Fe group, though less justified than to Ni, indicates that ferromagnetism should persist in that group down approximately to Fe. The criterion for ferromagnetism previously suggested by the author, the existence of inner unfilled electron shells (the $3d$), small in proportion to their distance apart, is justified. The calculation is not made according to Heisenberg's method, which is considered to be unsuitable for application to ferromagnetism, except in its general principle of explaining the energy of orientation of elementary magnets in terms of exchange energy.

AUTHOR.

2389. Arkadiew's Method of Eliminating Skin Effect to Study Dynamic Magnetisation Curves. O. Veletzkaia. *Zeits. f. Physik*, 99. 7–8. *pp.* 569–575, 1936.—The author has examined the viscosity bands in the magnetic spectrum of Fe sheet in which the skin effect has been absent [see Abstract 4716 (1935)]. He now considers both viscosity and skin effect in their influence on the dynamic magnetisation curves for Fe.

Using the method proposed by Arkadiew, the experimental results of Hermann and of Wilson are analysed and the influence of the two factors is shown. The experimental curves of permeability and magnetic loss, when freed from skin effect by this method, agree, in weak fields, with the corresponding curves of magnetic viscosity. H. J. H. S.

2390. Mechanical Force on Bodies of Small Susceptibility Due to Induced Magnetisation. G. Temple. *Phys. Soc., Proc.* 48. *pp.* 393–400, *May* 1, 1936.—The mechanical force on a body of any shape and of small susceptibility, when placed in a magnetic field, is expressed as an integral taken over the surface of the body. This principle is applied to the experimental arrangement adopted in Rankine's magnetic torsion balance [see Abstract 2209 (1934)] where a magnetic pole is attracted by the magnetisation induced in a spherical body. The results obtained are (1) a direct proof of Rankine's formula for a point pole ; (2) the correction for the earth's field ; and (3) the correction for the finite spread of the poles in an actual magnet. AUTHOR.

2391. Diamagnetic Susceptibility of Sulphuric Acid-Water Mixture. B. N. Rao. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 188–192, *Feb.*, 1936.—Data for the range 0–99·8 % H_2SO_4 are tabulated and plotted. There is considerable departure from the additive law, the maximum deviation being about 5 %. The curve shows no break to indicate the presence of hydrates in solution. The maximum deviation is, however, at a concentration corresponding to $H_2SO_4 \cdot 2H_2O$, the existence of which is supported from surface tension data. N. M. B.

2392. State of Rare-Earth Elements in Metal Lattice. V. I. Drožžina and R. I. Jaanus. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 72–80, 1936. *In English.*—An examination has been made of the relation between the temperature and the magnetic susceptibility of the rare earth elements Ce and Pr. The magnetic moment of Ce is 11·4 Weiss magnetons, and its Curie point + 6° K. ; whilst Pr has a moment of 16·0 *Mw* and a Curie point + 2° K. A comparison between the magnetic moments found experimentally and those calculated theoretically shows that in a metal lattice the elements under investigation are in the same state as when in trivalent chemical combination. G. E. A.

2393. Magnetic Properties of Colloidal Powders of Metallic Elements. S. R. Rao. *Current Science*, 4. *pp.* 572–575, *Feb.*, 1936.—A critical account is presented of the investigations on the magnetic properties of colloidal powders of metals. Three types of binding of the valency electrons in metals are contemplated : (1) metallic, (2) homopolar and (3) Ehrenfest-Raman. The influence of colloidalisation on the magnetic properties of metals in which these types of binding are present is mentioned. Attention is drawn to the experiments by Goetz on the effect of small quantities of foreign metals in Bi crystals. The close analogy between colloidalisation and cold-working in the case of metals wherein the metallic type of binding is predominant, is considered in the light of Honda and Shimizu's theory. Brief mention is made of the investigations on Ni powders and films in the light of Heisenberg's theory. AUTHOR.

2394. Magnetic Atomic Moments of Manganese Dissolved in Copper, Silver and Gold. G. Gustafsson. *Ann. d. Physik*, 25. 6. *pp.* 545–560, *March*, 1936.—An arrangement for the investigation of the para- and dia-magnetic susceptibilities of thin wires (0·75 mm.) is described and is used to estimate the atomic moments of Mn in the other

metals. Only a small amount of Mn is present in the alloy. Results are given for 6 Cu-Mn, 5 Ag-Mn, and 4 Au-Mn alloys at different temperatures and are discussed. W. R. A.

2395. Magnetic Susceptibility of Single Crystals of Lead, Thallium and Tin. S. R. Rao and K. C. Subramaniam. *Phil. Mag.* 21. *pp.* 609–624, *March*, 1936.—Single crystals of Pb, Tl and Sn are investigated by the Gouy method. No change of susceptibility is noted as the crystals of Pb or Sn are rotated about their cylindrical axes. The diamagnetic susceptibility of α-Tl parallel to the hexagonal axis is $0{\cdot}412$ in 10^{-6} units, and the value normal to this axis is $0{\cdot}165$. The magnetic anisotropy is $2{\cdot}5$, whereas the average for polycrystalline Tl is $0{\cdot}247$. On heating the Tl to 235° C., the β-variety is formed which has a mean diamagnetic susceptibility $0{\cdot}158$. When the Tl is melted at 300° C., the value becomes $0{\cdot}131$. The results are explained by assuming that in α-Tl two of the three valency electrons have their orbits in the hexagonal planes and that their binding is homopolar. The third electron is considered to be free. In the β-variety there are only Tl^{+1} ions, and the remaining electron in the atom is free. G. E. A.

2396. Magnetic Susceptibility and other Properties of Binary Mixtures of Organic Liquids. V. C. G. Trew and J. F. Spencer. *Faraday Soc., Trans.* 32. *pp.* 701–708, *April*, 1936.—The density, refractive index, heat of mixing, specific heat and magnetic mass susceptibility of a series of mixtures of the liquids benzene, toluene, *m*-cresol, aniline and nitrobenzene have been measured. None of the pairs of liquid mixtures can be considered as ideal with the possible exception of the nitrobenzene—*m*-cresol mixture which showed least deviation from the mixture law. Similar deviations were obtained for different properties for mixtures of benzene and toluene, respectively, with *m*-cresol, the wider apart the molecular weights of the constituents the more marked the deviation. For mixtures of nitrobenzene and aniline, respectively, with *m*-cresol, no general rule governing the deviation of the properties investigated could be discovered. The molar magnetic mass susceptibility proved to be a more nearly additive property than any other property investigated.

AUTHORS.

2397. Definition of the Electromagnetic Field by Means of Potentials, and the Magnetic Moment of the Electron. A. Proca. *Comptes Rendus*, 202. *pp.* 641–643, *Feb.* 24, 1936.—It is shown that the description of the electromagnetic field by the scalar potential ϕ and the vector potential A is incomplete, and that further solutions of Maxwell's equations are possible which are derived from another scalar and vector potential related to magnetic charge in the same manner as ϕ and A are related to electric charge. It is known experimentally that free magnetic charges do not exist, but it is incorrect to assume that the corresponding potentials are always nil. For the case of an electron at rest the general solution indicates the existence of a magnetic in addition to the usual electric field, and this must be ascribed to a magnetic moment of the electron. Thus, Maxwell's equations contain implicitly the result discovered later by other means that the electron is endowed with a magnetic moment. W. S. S.

2398. Probability Interpretation of the Electromagnetic Field. F. Prunier. *R.G.E.* 39. *pp.* 311–313, *Feb.* 29, 1936.—The author develops a parallelism between a plane wave in ψ, the four component argument in Dirac's theory of the electron, and a plane wave in classical electromagnetic

theory. This leads to a probability interpretation of the scalar and vector potentials. W. S. S.

2399. Combinations of Circular Currents for Producing Uniform Magnetic Field Gradients. L. W. McKeehan. *Rev. Sci. Instruments*, 7. *pp.* 178–179, *April*, 1936.—The theory of magnetic field gradient production by a limited number of circular current loops with a common axis is briefly restated. The best positions for combinations of two loops and four loops, carrying currents of equal magnitude, are computed. The best ratio of breadth and depth of winding for coils of rectangular section, approximating most closely to these ideal solutions are also computed. [See Abstract 1877 (1936).] AUTHOR.

2400. Axial Spin of a Magnet and Laws of Electromagnetic Induction. W. Cramp and E. H. Norgrove. *I.E.E., J.* 78. *pp.* 481–491, *April*, 1936.—The object of these experiments is to extend certain investigations by Faraday which have been the subject of much controversy. They concern the relations between a cylindrical magnet spinning about its axis and the currents and forces set up thereby in a neighbouring conducting circuit, of which the magnet may or may not form a part. The similarity between cylindrical magnets and solenoids is examined, as well as the effect produced by one spinning magnet upon another. The bearing of these experiments upon the laws of electromagnetic induction is explained, and certain special experiments on this subject are included. The conclusions reached are given in Section (15); and in an Appendix some practical applications are described.

AUTHORS.

2401. Empirical Formulæ for the Inductance of Circular Coils. J. Hak. *R.G.E.* 39. *pp.* 346–348, *March* 7, 1936.—The inductance L of a circular coil of n turns and mean diameter D may be written $L = n^2D\phi$, where ϕ is a function of the form of bobbin. When the depth of winding t is negligible ϕ is a function of $l/D = \alpha$, where l is the length of coil, and ϕ is given with high accuracy in Nagaoka's tables. When $\alpha > 0{\cdot}4$, π^2/ϕ varies approximately linearly with α, whence follow empirical formulæ of the type $L \doteqdot n^2D\pi^2/(p + q\alpha)$. The constants p and q may be chosen to make this formula exact for any two values of α. Formulæ are obtained in this way suitable for various ranges of α and their errors are determined and compared. When t is not negligible ϕ is a function of $t/D = \rho$ as well as α. The value of ϕ in this case may be obtained from ϕ_0, that for $t = 0$ and the same value of α, by the approximate formula $\phi = \phi_0 - \pi^2\rho(2 - \rho)/3\alpha$. L. H.

2402. Magnetic Field and Inductance of a Cylindrical Coil. K. Foelsch. *Arch. f. Elektrot.* 30. *pp.* 139–157, *March* 10, 1936.—This is a mathematical paper dealing with the calculation of the magnetic field due to the passage of a current around a cylindrical coil. Three-dimensional coordinate geometry is used and the problem is reduced to the solution of elliptic integrals. The values of the axial and radial components of the field are obtained and the results agree with those deduced by K. F. Müller. The calculations are applied to the cases of both single- and multi-layer cylindrical coils, and the results are illustrated by the substitution of actual values in the equations. The calculations give the value of the field at any point in space which is a distance x axially from one of the end planes of the coil, and a distance ρ radially from the coil axis. The solutions are quite different when ρ is either greater or less than the radius of the coil, in the case of the axial component of the field. The

radial component is obtained more easily. The calculations for the multi-layers coil are made by dividing the coil into coaxial elements. Approximate formulæ are deduced for the inductance of iron-free cylindrical coils.

A. C. W.

***2403. Shape of Core for Laboratory Electromagnets. H. B. Dwight and C. F. Abt.** *Rev. Sci. Instruments*, 7. *pp.* 144–146, *March*, 1936.—Laboratory electromagnets are usually constructed with conical poles, the angle between the surface of the cone and the axis being about 60° and the point being flattened in the region where uniform maximum flux density is desired. It is shown that, with this arrangement, there is a large amount of leakage flux (*i.e.*, flux from pole to pole through regions of low flux density and hence of no useful value). A curved shape of pole is described which is superior to the conical type in that the flux density between the pole faces is more uniform and greater for the same ampere-turns and the same weight. The principle of continuously increasing the cross-section of the core while leaving the air gap is advocated. In this way, sufficient iron is provided to carry the flux at any part of the core without unduly large ampere-turns per cm. and at the same time the leakage flux is reduced. H. J. H. S.

***2404. Electronic Measurement of Magnetic Fields. M. v. Ardenne.** *Hochfrequenztechn. u. Elektroakustik*, 47. *pp.* 43–45, *Feb.*, 1936.—The author applies the theory of the circulation of electrons in the magnetron valve to a new device for measuring with precision magnetic fields, between 200 and 1000 gauss, to within $\pm$ 1–2 %. A fine axial filament emits electrons from a spot of oxide and these curl round and strike a fluorescent screen on the inside of the circular anode provided the relation between the anode voltage and the field strength is within narrow limits, both of which rise together. The associated circuit, which provides the variable anode supply up to 3000 volts, is described, the anode area being represented by 3 mm. diameter. L. E. C. H.

***2405. Measurement of Strong Magnetic Fields. G. H. Briggs and A. F. A. Harper.** *Journ. Sci. Instruments*, 13. *pp.* 119–126, *April*, 1936.—A magnetic balance for the measurement of extensive magnetic fields of 50–10,000 or more gauss is described in which the force acting on a coil of rectangular form carrying a known current is measured with an ordinary physical balance. The sensitivity of the apparatus is such that strong fields may be compared to a few parts in 10^6 and fields of 10,000 gauss measured in international units to a few parts in 10^5. The coil consists of ten turns of bare copper wire mounted on a sheet of glass so that its mean width, which is about 16 cm., can be accurately determined. It is shown that the magnetising effect of the coil on the permanent magnet or electromagnet whose fields are measured can be eliminated. Measurements of less accuracy obtained by a search coil method are also described.

Authors.

See also Abstracts 2011, 2028, 2029, 2030, 2031, 2276, 2293, 2341, 2343, 2350, 2372, 2430.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***2406. Electrocardiograph Recorder. H. Portier.** *Onde Élec.* 15. *pp.* 102–112, *Feb.*, 1936.—A description of a practical form of ondograph applied to electrocardiography. The e.m.f.s. generated between different parts of the heart and surrounding tissues are used to operate the ondograph directly by means of a suitable valve amplifier and rectifier. Typical equipotential points are plotted on a chart of the chest and

positions found for the application of the electrodes on the patient's body. The resulting wave-form is of constant type although varying in detail. The apparatus comprises an amplifier and modulator for an auxiliary supply of 1000 ~, further amplification and final rectification for application to the ondograph. Alternative outline circuits are given.

E. H. W. B.

***2407. Production and Therapeutic Action of Ultra-Short Waves (80 cm.). A. Denier.** *J. de Radiologie et d'Electrologie*, 20. *pp.* 193–197, *March*, 1936.—Briefly describes and illustrates an apparatus to produce ultra-short waves for therapeutic purposes. It is claimed that the effects of such radiation is due to cellular oscillation and not simply that of heat. Haricot beans have been irradiated in glass, porcelain and iron vessels with a constant negative effect in respect to glass, a slight effect in respect to porcelain and a triple effect in respect to iron. Details are also given of irradiation of seeds, rats and rabbits, it being found that when such radiation is combined with radiotherapy, the effect of the latter is increased. In respect to human subjects details of combined treatment with ultra-short waves and radiotherapy are given and remarkable therapeutic results are reported. It is considered that ultra-short wave therapy increases the radiosensitivity of tumours. B. J. L.

2408. Thorium Hydroxide Sols as Opaque Media in Radiography. T. O. Menees and J. D. Miller. *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 194–199, *Feb.*, 1936.—Guthmann and Stahler have previously utilised thorium dioxide sols to give radiograph relief of the interior uterus. From their results they considered a less acid relief agent necessary and, to satisfy this requirement, the authors have produced thorium hydroxide sols. Such solutions are quite stable but coagulate in an alkaline medium or in any colloidal solution having particles of opposite charge. Their use in respect to uterine investigations is illustrated, where the coagulum forms a coating upon the wall in an alkaline medium. In acid media coagulation does not result and this makes it unsuitable for investigations as of the stomach, irrespective of the fact the cost of investigation by this means becomes prohibitive. The chief use has been found in respect to the uterus, sinuses and fistulæ, whereas it is not satisfactory in the nasal sinuses, oesophagus, bladder, or urethra. B. J. L.

***2409. Historadiography. P. Lamarque.** *Comptes Rendus*, 202. *pp.* 684–685, *Feb.* 24, 1936.—A brief description is given of an apparatus designed to produce radiographs of histological sections. The slide container, camera and X-ray tube are all evacuated by the same pumping system, thus avoiding air absorption and enabling short exposures at very low kilovoltages (of the order of 5 kV) to be used. Lippman emulsion was used on the films, the grains being invisible even with a magnification of 650*D*. The cells in the sections examined showed considerable variations in opacity amongst themselves and the structure of individual cells can easily be observed. It is suggested that the method may in many cases be used in the place of the more usual staining methods of examination; and it may be possible to locate chemical substances which have been introduced into the tissues. J. E. R.

2410. Illumination of X-Ray Radioscopic Rooms. M. Saget. *J. de Radiologie et d'Electrologie*, 20. *pp.* 155–158, *March*, 1936.—In X-ray radioscopic procedures for maximum observation of the fluorescent screen appearances, prior accommodation of the observers' eyes is essential and this may entail a period of adjustment as long as half an hour. The author

discusses the general arrangement of the room as regards prevention of entry of light and a device in which 1 to 9 sheets of paper, so numbered, are viewed to determine the degree of ocular accommodation. The lamps lighting the room are regulated by adjustable resistances and there may be automatic illumination as soon as screen observation is ended. Ledoux-Lebard has utilised sodium vapour lamps, which are monochromatic and permit best visibility with minimum intensity. These are screened by neodymium-oxide glass so that the illumination of the X-ray screen is practically unaffected, whilst the room illumination is absorbed by the oxide screen and, it is claimed, the X-ray screen contrast is increased, to such an extent that screen observation can be carried out and a projectile extracted whilst the room is so illuminated. B. J. L.

***2411. Direct Radiokinematography. M. van de Maele.** *J. de Radiologie et d'Electrologie*, 20. *pp.* 163–165, *March*, 1936.—In the indirect method of radiokinematography the X-ray energy is transformed to light upon a fluorescent screen for registration upon the kinematographic film. The method is not applied to the body as a whole, but only to those particular parts under investigation and, for a film size of height 12 cm., for obtainance of 16 images per sec. a speed of film of just under 2 m. per sec. is necessary. The author has employed both roll films and rapidly substituted individual films. The X-ray tube employed is the Rotalix 20 kW tube, which will allow at 80 kV a tube current of 80 mA for 20 sec. A difficulty is to avoid undue exposure of the patient and details of the dose received by the patient are given. The method using individual films has been employed and is preferred, since vibration is avoided by use of rotatory movment, it is easily adaptable to existing apparatus, and film development is facilitated. The author considers this is the method of election and the direct method generally is superior to the indirect method, in giving better anatomical detail. Typical films are illustrated. B. J. L.

2412. Modification of Radiosensitivity by means of Readily Penetrating Acids and Bases. R. E. Zirkle. *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 230–237; *Disc.*, 237; *Feb.*, 1936.—Various factors influence the biological response to irradiation by X-rays and γ-rays. One factor is the intracellular concentration of CO_2. To investigate this particular factor, fern spores and paramecia are utilised, the method of investigation being that, after preliminary light radiation to allow the spores to absorb water, batches of spores are simultaneously irradiated in three identical chambers rotated during irradiation to ensure exactly similar conditions. In respect to the fern spores it is found that the radiosensitivity is definitely increased by the presence of CO_2 and H_2S and, with NH_3, first decreased and then increased. The radiosensitivity of paramecia is also increased by CO_2. Without the presence of an acid or base, no detectable effects are produced without irradiation. It is suggested there may be some condition between the maximum of radiosensitivity observed at 0·006 *M* CO_2 and the maximum of flocculability of proteins when kept at their isoelectric points during irradiation. B. J. L.

***2413. Use of Two X-Ray Tubes for Total X-Ray Therapy. P. Marques.** *J. de Radiologie et d'Electrologie*, 20. *pp.* 181–186, *March*, 1936.—Mathematical and graphical details are given of the distribution of X-ray intensity when two X-ray tubes are simultaneously used for X-ray therapeutic radiation. The advantage of two tubes is that the time of irradiation is essentially shortened, as compared to use of a single tube,

since the latter must be actuated at a greater distance from the patient, and, with the particular arrangement utilised by the author, the intensity with the two tubes is 9 fold and, conversely, the time of irradiation one-ninth of that of a single tube at a distance of 3·60 m. The effect of filters is not inferior as compared with that of a single tube. Measurements made by an ionisation chamber show that Lambert's law does not apply as the intensity is proportional to cos 2x (angle of emission) and not cos 3x (angle of emission), the difference being that the ionometer measures the radiant flux and not the intensity per unit of surface irradiation. As respects the filtration effect of use of a large tube distance, it is found that this is not sensibly modified beyond 1·5 m. B. J. L.

2414. Biological Effects of X-Rays. G. L. Clark. *Radiology*, 26. *pp.* 295–312, *March*, 1936.—The paper is purely biological, dealing with the lethal bactericidal effects of X-rays, the use of such effects for dosimetry, the effect of hereditary in respect to the biological material, radiosensitivity of cells, the recovery of the irradiated material, particularly in respect to the time factor, the effects of X-rays on human tissues, photochemical effects, reactions to irradiation particularly in respect to cancer treatment and the possibility of utilising X-ray determination of the fine structure of tissues, in respect to diagnosis of pathological conditions. B. J. L.

***2415. Guarded Field X-Ray Ionisation Chamber. L. S. Taylor and G. Singer.** *Radiology*, 26. *pp.* 322–325, *March*, 1936.—The U.S.A. Bureau of Standards [see Abstract 1250 (1936)] utilises an X-ray ionisation chamber of their own design which has previously been described. In the present paper the elimination of error in respect to the distribution of potential between guard wires, ionisation between these wires, diaphragms used with the instrument, creepage of charge, temperature and current compensation are discussed. B. J. L.

***2416. Zinc Filters. R. S. Landauer.** *Radiology*, 26. *pp.* 478–479, *April*, 1936.—In X-ray treatment by the Coutard method zinc filters are commonly used. Data and an absorption curve for copper and zinc are given which show with specific thicknesses of either metal, there is no significant difference of intensity or quality of X-ray beams filtered *via* either metal of appropriate thickness. B. J. L.

2417. Measurements of Low-Voltage X-Rays (Chaoul Technique). W. V. Mayneord. *Brit. J. of Radiology*, 9. *pp.* 215–238; *Disc.*, 238, *April*, 1936.—An account is given of measurements of X-rays produced at 60 kV and used at small (5 cm. and 3 cm.) focal skin distances. A new type of distribution dosage-rate meter is described, suitable for such work. Spectroscopic and absorption measurements of "quality" give an average wave-length of about 0·32 Å. The X-ray output of such apparatus is such that at 5 cm. f.s.d. the dosage rate is about 25 r/min. ma. Investigations are described of back-scatter, percentage depth dose and complete distribution of radiation. The results of measurements of stray radiations are also recorded. Some theoretical possibilities of mathematical study of the dosage distribution problem are indicated. AUTHOR.

2418. Evaluation in Röntgens of the Barium-Platinocyanide Pastille Dose for X-Rays and γ-Rays. G. W. C. Kaye and W. Binks. *Brit. J. of Radiology*, 9. *pp.* 272–279, *April*, 1936.—The B-dose of normal barium-platinocyanide pastilles has been calibrated in röntgens for a variety of qualities of X-rays, as generated by various types of X-ray tubes, when excited by either constant voltages or induction-coil pulsating voltages ranging from 50 to 180 kV, the radiation being either unfiltered

or passed through filters of various thicknesses. The pastille dose was found to range from about 500 r. for soft X-rays to a minimum of about 240 r. for medium rays, afterwards rising to about 360 r. for hard rays. The results are compared with those of previous workers and explanations are advanced for certain discrepancies. It is believed that, if only on the scores of simplicity and inexpensiveness, there is still a restricted sphere of utility for the pastille and tintometer when properly used. The pastille will also serve as a dosemeter for radium γ-rays of high dosage-rate, for which, with a filter of 0·5 mm. Pt., the B-dose is about 13,000 r.

AUTHORS.

2419. Biological Action of Neutrons. J. H. Lawrence and E. O. Lawrence. *Nat. Acad. Sci., Proc.* 22. *pp.* 124–133, *Feb.*, 1936.—Two reasons are put forward for a possible large biological effect of neutrons: (1) The ease of absorption of the particles by substances of low atomic number, such as are present in tissues. (2) The intense ionisation, compared with electrons, of the recoil nuclei, particularly protons, set free in the absorption processes. Changes produced in the blood picture of rats was chosen as a convenient indicator of biological action. The neutrons were produced by bombarding a Be target with several μA of 3·5 eMV deutons. Ionisation produced by the neutrons was measured in an ionisation chamber calibrated for X-rays in "r" units. The dosage rate, however, was multiplied by a factor of 2·1 to take into account the excess of H present in tissues. During the actual exposures a piece of S was place in the beam and the radioactivity induced in this, after calibration served as a useful indicator of the total dose. The most pronounced feature of the blood changes produced by both X-rays and neutrons is a rapid fall in the number of lymphocytes. These experimental results show that for irradiation in terms of röntgens, neutrons are roughly ten times as biologically effective as X-rays, in respect to alteration in the blood picture of the rat; and from the above considerations, per unit of ionisation in the animal, neutrons are possibly five times as biologically effective. As the ion density produced by neutrons is more than 100 times greater than that of X-rays, it is suggested that biological effect is a very slowly varying function of ion distribution. This suggests that the biological effectiveness of X-rays should vary very little with wave-length, as the ion distribution varies only slowly over the whole wave-length range. The question of protection of workers against the effects of neutrons is briefly discussed.

J. E. R.

2420. Relative Effectiveness of X-Rays and Fast Neutrons in Retarding Growth. R. E. Zirkle and P. C. Aebersold. *Nat. Acad. Sci., Proc.* 22. *pp.* 134–138, *Feb.*, 1936.—Wheat seedlings, prepared so that the primary roots were just beginning to emerge, were exposed to a beam of neutrons produced by the bombardment of Be with high speed deutons. 48 hours after irradiation the lengths of the primary and lateral shoots were measured. The dosage rate of the neutrons was varied from 0·4 to 2 r. per min., sulphur targets being used as radioactive integrating dosemeters during the exposures. The X-ray exposures were made at a dosage rate of 15 r./min. using heavily filtered 900 kV radiation. The results are expressed in terms of the rate of growth of the irradiated seedlings as a percentage of the normal rate. Allowing for the different modes of ionisation of the two types of radiation, the biological effectiveness per ion produced by neutrons is roughly ten times that per ion produced by X-rays. Although much uncertainty exists, there is some evidence of a selective

effect between different biological materials in the biological action of neutrons. J. E. R.

2421. Tissue Dosage from Interstitial Radiation. M. C. Reinhard and H. L. Goltz. *Radiology*, 26. *pp.* 356–359, *March*, 1936.—Reports ionisation measurements to show the relation of intensity of gold radon seeds at 1 cm. distance from a point source to 100 mm., for the determination of depth dose for applicators of various lengths. From the measurements made calculations are presented in tabular form, to render it possible to estimate dosage in terms of skin erythema under standard reproducible conditions. Radium needles of various lengths are also considered. B. J. L.

2422. γ-Ray Protection Afforded by Building Materials. G. W. C. Kaye, G. E. Bell and W. Binks. *Brit. J. Radiology*, 9. *pp.* 161–170; *Disc.*, 170–171, *March*, 1936.—The present paper, which is a continuation of a previous one [see Abstract 1282 (1935)] concerns the protective values of building materials as regards γ-rays from Ra. Transmission measurements carried out both with wide and narrow beams of rays showed that the so-called "density law" of γ-ray absorption is only roughly valid when light and heavy elements are compared, but is reasonably true for light elements. Curves are given showing how the absorption of various walls depends on the weight per unit area of the wall. The results refer to Pb, Fe and to ordinary brickwork. G. E. B.

See also Abstracts 2256, 2261.

OSCILLATIONS AND WAVES.

***2423. Differential Impulse Generator. Mong-Kang Ts'en.** *Chinese Journ. Phys.* 1. *pp.* 68–78, *Oct.*, 1935. *In English.*—A new method of generating electric impulses of short duration with good amplitude and steadiness is devised by superposing two similar and opposite impulses produced with two glow-discharge tubes. Confirming experiments are made and fully reported. A useful formula for passing an impulse through a transformer is also derived. AUTHOR.

***2424. Generator Producing Sinusoidal Oscillations, of Constant Amplitude, over a Wide Range of Frequencies. A. M. Monnier and J. Bazin.** *Comptes Rendus*, 202. *pp.* 828–830, *March* 9, 1936.—The four arms of a bridge are made up of resistances r_1, r_2 and capacities C_1, C_2, a resistance R, divided into two parts R_1, R_2, being connected in the diagonal joining one terminal of each condenser to one end of each of the resistances r_1, r_2. The time-constants r_1, C_1 and r_2, C_2 are unequal and R is small with respect to r_1 and r_2. Under these conditions oscillations can be maintained if the mid-point of R_1 R_2 is connected to the kathodes of two valves, the other ends of R_1 and R_2 being connected to the batteries supplying the anodes and the ends of the other diagonal connected to the grids of the two valves. By the use of pairs of condensers of constant ratio and simultaneous variation of the resistances r_1, r_2, a wide range of frequencies can be obtained without alteration of R_1, R_2. The oscillations have been found to be sinusoidal and remarkably constant in amplitude. Using capacities and resistances of values easy to realise in practice it has been found possible to obtain oscillations of frequency greater than 30 kc./s. and ranging down to 1 $\sim$ in about 30 sec. A. W.

***2425. Electronic Oscillator with Parallel Plane Grids. W. A. Leyshon.** *Phys. Soc., Proc.* 48. *pp.* 469–475; *Disc.*, 475–476, *May* 1, 1936.—The paper describes results obtained with an experimental valve, the electrode system of which consisted of two parallel plane grids with two symmetrically arranged kathodes external to them. When Lecher wires are attached to the two grids, oscillations can be obtained either (A) with the valve used as a triode, potentials being applied to the grids in the usual way for the production of Barkhausen-Kurz oscillations, or (B) with both kathodes emitting and the two grids at the same positive potential. The longest waves generated with the B connection satisfy the relationship $\lambda^2 v_g$ = constant. For both A and B the wave-lengths of the generated oscillations are determined almost entirely by the length of the attached Lecher wires. The behaviour of the B system shows some resemblance to that of a relaxation oscillator maintaining, and coerced in frequency by, a vibrator of small damping. AUTHOR.

2426. Decimetre Waves. H. Lotze. *Hochfrequenztechn. u. Elektroakustik*, 47. *pp.* 37–43, *Feb.*, 1936.—The author studies the damping and effect of anode and grid voltages in an electron pendulum oscillator having double Lecher-wire coupling. A measured efficiency of about 5 % was obtained with production tubes and optimum circuit conditions. The damping of the circuits and of the unheated valve are measured. It is shown that with higher frequencies a higher external resistance for the same motion of electrons and conversion efficiency is possible, the h.f. voltage and the initiation of oscillation being determined by the electrode capacity. L. E. C. H.

***2427. Limit of Charge Sensitivity of the Valve Electrometer. H. Alfvén.** *Zeits. f. Physik*, 99. 1–2. *pp.* 24–41, 1936.—The charge sensitivity of a valve amplifier, used as an electrometer, is limited by the shot effect and by thermal fluctuations in the first valve. The dependence of these disturbances upon the properties of the valve and upon the conditions of experiment are discussed theoretically and the conclusions compared with experimental observations. With the particular amplifier used the mean error in the measurement of a quantity of charge communicated momentarily to the grid is found to be about 150 electrons or $2{\cdot}4 \times 10^{-17}$ coulomb. L. A. W.

***2428. Dynamically Controlled Amplifier and Pure Tone Regulation. W. Bürck, P. Kotowski and H. Lichte.** *E.N.T.* 13. *pp.* 47–73, *Feb.*, 1936.—The sphere of application of controlled transfer arrangements dependent on amplitude is first discussed and an account is given of the means which should be adopted to obtain the practical realisation of the control desired. It is shown that the equalisation effects due to the regulators may cause difficulties, which are investigated theoretically and experimentally. Numerical calculations are made regarding the relations between the control time constants, "rattle" factor and transfer frequency band, for pure tone control and simple cases of dynamic regulation. Experimental work confirmed the theoretical results. The different types of dynamic control are described and their particular properties elucidated. The combination of regulators is also investigated and a general review of possible practical arrangements is given. A number of practical rules are given with reference to the design of controlled l.f. amplifiers. A. W.

***2429. Design of Tuned Resistance-Capacity Coupled Amplifiers. E. A. Johnson.** *Physics*, 7. *pp.* 130–132, *March*, 1936.—The behaviour of resistance-capacity coupled amplifiers is studied with regard to their

behaviour as resonant networks. Expressions are obtained for the optimum value of circuit constants, and the design procedure is developed. Tuning at 1 ~ has been successfully applied to low noise amplifiers.
AUTHOR.

2430. Propagation of Electromagnetic Waves in Non-Homogeneous Media. V. Kupradze. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 1. *pp.* 7–9, 1936. *In German.*—Extending a previous investigation [see Abstract 1984 (1934)] the author considers the propagation of electromagnetic waves in the two-dimensional case when the medium contains a series of finite regions, each region being enclosed in the previous one of the series, the electromagnetic constants undergoing a discontinuous change at the boundary of each region. W. S. S.

2431. Radio Exploration of Upper Atmospheric Ionisation. E. V. Appleton. *Phys. Soc., Reports,* 2. *pp.* 129–165, 1935.

2432. Ionisation of the Earth's Upper Atmosphere. L. V. Berkner. *Am. Geophys. Union, Trans. pp.* 20–26, 1935.—A *résumé* is given of the present state of knowledge of the properties of the various layers of the ionosphere, as revealed by the researches of numerous investigators in different parts of the world. Particular attention is paid to diurnal, annual, sporadic and long-period variations of the height and ionisation of the different layers. A. W.

2433. Ionospheric Layers over China. Mong-Kang Ts'en and Ngaisi H. Chang. *Chinese Journ. Phys.* 1. *pp.* 92–100, *Oct.*, 1935. *In English.*—The paper gives a preliminary report on ionospheric layers over China, reporting a 24-hour measurement of the virtual heights on a summer day in Shanghai, which reveals all the salient features of the lower (E) and upper (F) layers. AUTHORS.

2434. Ionospheric Studies in India. S. K. Mitra. *Nature,* 137. *pp.* 503–504, *March* 21, 1936.—A review is given of the results of ionospheric observations carried out at various stations in India since 1930. Measurements of the equivalent height of the lower E-region gave an average value of 90 km., which is about 10 % less than the value found in England by the same method. Direct measurement of the ionisation density by Appleton's method showed that during the summer solstice (1933) the E-ionisation density at midday was more than 5×10^5 equivalent electrons, as compared with the corresponding average value in England of $1{\cdot}8 \times 10^5$. At midnight the E-ionisation density was less than 2×10^5 for the greater part of the year, and the F-density also less than 2×10^5 in April, May and June. The maximum value of the F-density was found to be more than $1{\cdot}5 \times 10^6$, which is much greater than the value obtained in higher latitudes. Thunderstorms were found to increase abnormally the E-region ionisation. A. W.

2435. Ionosphere Studies during Partial Solar Eclipse of February 3, 1935. S. S. Kirby, T. R. Gilliland, and E. B. Judson. *Bureau of Standards, J. of Research,* 16, *pp.* 213–225, *March*, 1936.—Virtual height and critical-frequency measurements of the several regions of the ionosphere were made during the day of the solar eclipse of February 3, 1935, and during several days before and after the eclipse day. The eclipse was found to produce a decrease of the critical frequency of each region. The decrease of critical frequency was approximately in time phase with the eclipse, thus indicating an ionising agency (probably u.v. light), originating in the sun and propagated at approximately the velocity of light. The decrease of equivalent electron density in each region

during the eclipse was compared with the decrease in the exposed area of the sun's disc, and found to indicate that the ionisation of the normal E-region was diminished when the ionising agency was decreased, by recombination of + and − charges, while the ionisation of the F_2-region and a high stratum of the E was diminished by a process of attachment of electrons to neutral particles. AUTHORS.

2436. Ionisation Changes in the Highest Atmospheric Layers during Auroræ and Magnetic Storms. L. Harang. *Gerlands Beitr. z. Geophys.* 46. 4. *pp.* 438–454, 1936.—The variation of the ionisation in the E- and F-layers of the atmosphere are studied by radio echoes. The daily noon values are given at Tromsø from April to Nov. 1935, and are shown by curves. Continuous records are made over 36 hrs. for calm days and days showing storms and auroræ by finding the critical frequencies. Auroræ and earth magnetic storms show a great increase of ionisation in the E-layer, but a decrease in the ionisation of the F-layer. H. M. B.

2437. Terrestrial Magnetism and Short-Wave Communication. H. E. Hallborg. *I.R.E., Proc.* 24. *pp.* 455–471, *March*, 1936.—The functioning of short-wave circuits is found to be closely related to the geographical distribution of terrestrial magnetic activity. Circuit fading and magnetic fluctuations may be correlated in terms of horizontal intensity communication limits. North American magnetrogram studies have provided a direct relationship between short-wave communication effectiveness and north latitude. The world may be allocated into zones of commercially effective, distributed, and dead sectors with respect to any communication centre. The relative performance of east-west *versus* west-east transatlantic communication, and the application of magnetic analysis to international broadcasting is considered. The magnetic history of the year 1932 with respect to mean intensity and range shows the core of the earth to have magnetic retentivity. The correspondence of magnetic, earth current, and signal variations is illustrated. Europe is more favourably located geographically and diurnally with respect to freedom from terrestrial disturbances to communications than North America. A knowledge of concurrent magnetic activity, and the systematic charting of its cycles of daily variations is found essential to the most effective use of facilities, at all times and seasons, in the maintenance of a world-wide radio communication service. AUTHOR.

See also Abstracts 2094, 2106, 2342, 2404, 2407.

PHOTOELECTRICITY.

2438. Theory of the Surface Photoelectric Effect in Metals. Part II. K. Mitchell. *Roy. Soc., Proc.* 153*A*. *pp.* 513–533, *Feb.* 1, 1936. —The author's theory of the surface photoelectric effect in metals [see Abstract 4361 (1934)] is applied to calculate energy distribution curves and spectral distribution curves for polarised and unpolarised light. A selective maximum and high polarisation selectivity are shown to follow from the theory. Surface roughness may afford an explanation of the absence of polarisation selectivity, but not for the difference between spectral distribution curves for light polarised parallel and perpendicular to the plane of incidence nor for the so-called " normal " spectral distribution curves without maxima. Good agreement is obtained with experimental results on the spectral distribution curves of alkali metals with unpolarised light. The total energy distribution curves are in good

agreement with recent observations, showing a most probable energy close to the maximum energy of emission. The magnetic deflection velocity distribution curves are likewise in satisfactory accord with experiment. Normal energy distribution curves are also given. L. A. W.

2439. Influence of Auxiliary Irradiation on the Crystal Photoelectric Effect of Cuprous Oxide. N. O. Barbaumow and R. G. Jensch. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp.* 94–96, 1936. *In German.*—A concise account is given of experiments on cuprite crystals irradiated by an auxiliary transverse beam of monochromatic light from a 12-W lamp in addition to the main irradiation by a monochromatic beam from a 1000-W lamp. It is observed that the photoelectric effect of both beams together may be greater than the sum of the effects of the beams separately. Curves are given showing the photoelectric effect plotted against the wave-length of the main beam (range 440 to 760 $m\mu$) for the cases where there is no auxiliary irradiation, and where the auxiliary beam has each of the wave-lengths 540, 620 and 720 $m\mu$ in turn, the photoelectric effect due to the auxiliary beam alone being always suitably compensated. L. A. W

2440. Photoelectric Effect of Aluminium Films Evaporated in a Vacuum. E. Gaviola and J. Strong. *Phys. Rev.* 49. *pp.* 441–443. *March* 15, 1936.—Sensitivity curves of Al films deposited by evaporation *in vacuo* are determined. A new threshold value of 2830 Å and a selective maximum around 2700 Å are found. The cell has the form of a horn, absorbing all the incident light. Charcoal is used for producing high vacuum and for giving off gases that influence the position and inclination of the sensitivity curves. AUTHORS.

2441. Influence of Nature and Position of Substituting Groups on Photopotential of Substituted Aromatic Amines. (Miss) Hoang Thi Nga. *Comptes Rendus*, 202. *pp.* 1049–1050, *March* 23, 1936.—The photopotential of various o-, m- and p-substituted anilines is determined using a Hg lamp, the substances examined are in 0·05 *N* solution and on a Pt support. Their absorption curves are also determined at 18° in aqueous solutions (0·05 *N*) of KI, KCl, K_2SO_4, $CuSO_4$, $NaHCO_3$ and $KClO_3$. The photopotential of the m-derivatives is always > that of the ortho, but those of m- and p-derivatives are approximately the same.
C. A. S.

***2442. Secondary Emission Multiplier. V. K. Zworykin, G. A. Morton and L. Malter.** *I.R.E., Proc.* 24. *pp.* 351–375, *March*, 1936.—This paper describes the construction, theory, and performance of various types of fixed field secondary emission multipliers. Detailed consideration is given of multiplier photo-tubes employing crossed electrostatic and magnetic fields and of electron multipliers using electrostatic focusing alone, to serve as coupling and amplifying units for kathode-ray tubes such as the "Iconoscope." It is shown that while the power required for the operation of the secondary emission multiplier is about the same as that for the conventional amplifier, it is superior to the latter from the standpoint of noise. In the case of the multiplier photo-tube the signal-to-noise ratio is essentially determined by the shot noise of the photo-emission, and is therefore 60 to 100 times greater than that for a thermionic amplifier and photo-tube under conditions of low light intensity. Multiplier photo-tubes have been built with an amplification factor of several millions and serve to replace the conventional photo-tube and accompanying amplifier system. Their low "noise" level, together with their excellent frequency response and

extreme simplicity, makes these electron multipliers a very satisfactory form of amplifier. AUTHORS.

2443. Primary Photoelectric Current in NaCl Crystals. W. Thiele. *Ann. d. Physik*, 25. 6. *pp.* 561–568, *March*, 1936.—In NaCl crystals in which the colour-centres have been produced by thermal diffusion of the ions, the behaviour of the primary photoelectric current is shown to be the same as that previously demonstrated in crystals where the colour centres have been produced by X-irradiation. The excitation of the loosely-bound colour-centres under illumination is shown to be present at 135° C. in the same way as at room-temperature, the mean life-period being about 20 sec. Contrary to earlier suppositions, no inter-dependence is found between the excitation and the local polarisation fields. D. H. F.

***2444. Characteristics of Photoconductive Cells. O. P. Fuchs and H. Kottas.** *Zeits. f. techn. Physik*, 17. 2. *pp.* 47–53, 1936.—The relations due to Barnard and to Fournier d'Albe, representing the behaviour of Se photoconductive cells, are tested and found to have only a limited validity. The authors find that as a rule the ratio of the logarithm of the current to that of the applied voltage is a constant under a given illumination, over a wide range. Expressions representing the fatigue and lag effects are also given. Oscillograms showing the current changes corresponding to irregular variations in the light intensity are reproduced. D. H. F.

***2445. Properties of Selenium Blocking-Layer Photoelectric Cells. G. Marchal and L. Marton.** *Rev. d'Optique*, 15. *pp.* 1–11 *Jan.*, 1936.—Using a Weston photronic cell corrected with a filter to the spectral sensitivity curve of the eye the authors study the deviation from proportionality between current and illumination over the illumination range 0·2 to 10 lux. The ratio current/illumination is found to vary by 20 % in this range for white light. Using coloured light the deviation found is much less for red than for blue or green light giving rise to a kind of Purkinje effect. At illuminations in excess of 5 lux the cell current shows a continuous diminution with time, different cells even of the same make exhibiting wide differences in this respect. This fatigue effect is found to increase with the intensity of illumination and it is recommended that to obtain reproducible results an illumination of 25 lux should not be exceeded. Some measurements of the effect of interrupting the illumination for repeated periods of one minute are also reported. W. S. S.

2446. Becquerel Effect and Photochemical Sensitiveness of Fluorescent Dyes. Cécile Stora. *Comptes Rendus*, 202. *pp.* 408–410, *Feb.* 5, 1936.—Comparison of the photoelectric effects of dyes of the xanthane and quinonediimide groups in aqueous solutions of glycerol of varying concentration, combined with previous results, shows that the photoelectric effect and photochemical sensitiveness both result from oxidation and reduction dependent on the chemical constitutions of the dyes, and also on the nature of the solvent; the photoelectric effect varies greatly with the fluorescence. C. A. S.

2447. Barrier Layers in Photoelectricity. J. Roulleau. *Comptes Rendus*, 202. *pp.* 470–472, *Feb.* 10, 1936.—In this brief note the author points out that both the rectifying property and photoelectric property of the cuprous-oxide cell are independent of the specific resistance of the mass of the cuprous-oxide but both increase with the contact resistance of

the layer and are therefore connected by this property. Claims have been made that cuprous-oxide rectifiers have been made which are not photoelectric and likewise cuprous-oxide photoelectric cells which are not rectifiers; explanations are put forward to account for these claims which are shown to be not fundamental but due to disturbing effects.
F. S. B.

2448. Temperature Effect in Cu_2O Rectifier Photo-Cells. J. Roulleau. *Comptes Rendus*, 202. *pp.* 749–751, *March* 2, 1936.—The author plots the photoelectric output ϵ of a number of Cu_2O–Cu cells against the resistance R of the contact between the two layers, and finds the variation of the curve with temperature. As the temperature increases the curves are displaced in the direction of increasing ϵ with no change in shape. The displacement is not proportional to temperature, and at ordinary temperatures is about 1 % in ϵ per ° C. It follows that in any cell the variation of ϵ with temperature is a function of R, and this explains the wide range of temperature coefficients observed in cells of this type. D. H. F.

See also Abstract 2329.

PIEZOELECTRICITY.

2449. Electrification by Torsion in Quartz Crystal. Ny Tsi-Zé and Tsien Ling-Chao. *Chinese Journ. Phys.* 1. *pp.* 41–53, *Oct.*, 1935. *In English.*—A right hollow circular cylinder of quartz having its generator parallel to the principal axis liberates electricity when subjected to torsion about its axis. Charges of opposite signs appear on the inner and outer surfaces. When torsion is applied in the same sense as that of the optical rotation, positive electricity is developed on the outer surface, and *vice versa*. The quantity of electricity produced by the action of a couple of moment C on a hollow quartz cylinder of external diameter d_o, internal diameter d_i and length l is $klC/d_o(d_o-d_i)$, where k is equal to $9{\cdot}2 \times 10^{-8}$ in absolute c.g.s. electrostatic units. AUTHORS.

2450. Effect of Temperature on the Piezoelectric Modulus of Quartz. A. Langevin. *J. de Physique et le Radium*, 7. *pp.* 95–100, *Feb.*, 1936.—The quartz plate provided with graphite electrodes is placed in an oven, and the weights are applied so as to produce extension. The modulus decreases linearly by about 10 % between 20° C. and 200° C. D.c. conductance measurements show that the conductance is mainly a volume effect, not a surface effect. Between 20° C. and 200° C. the conductance increases exponentially with the temperature. P. V.

2451. Variation with Temperature of the Piezoelectric Effect in Quartz. A. Pitt and D. W. R. McKinley. *Canad. J. of Research*, 14. *Sect.A. pp.* 57–65, *March*, 1936.—As a result of some previous experiments [see Abstract 3585 (1935)] there were indications that the elastic vibrations set up in quartz showed an anomalous property at the temperature of liquid He. In order to decide this point, experiments were carried out on the piezoelectric activity of quartz at progressively lower temperatures until that of liquid helium was reached. Although a decrease in this activity of only 1 % had been observed by others working over the range from room-temperature to liquid H_2 temperatures, the present experiments show a total decrease of 12 % at the temperature of liquid He. Two methods were used, a statical method employed where the temperature could be held constant, and a dynamical method to ascertain the temperature at which any marked change in activity would just become evident.

Results by the dynamical method indicate that a sudden decrease in activity occurs at about 5° K. In addition, the dynamical method was extended to higher temperatures, so as to include in this paper values of the piezoelectric activity of quartz from 4° K. to 813° K. AUTHORS.

*2452. **Piezoelectric Quartz Crystals. I. Koga.** *I.R.E., Proc.* 24. *pp.* 510–531, *March*, 1936.—The chief characteristics of quartz plates cut at various angles to the crystal axes are described, with particular attention to the effect of temperature on frequency of oscillation. Methods of reducing these temperature effects lead to the manufacture of zero temperature coefficient plates. Their application to existing transmitters previously employing X-cut plates is described. Particularly stable oscillators using two crystals in a single circuit are also described. AUTHOR.

See also Abstracts **1964, 2042.**

THERMIONICS.

2453. Fluctuation Noise in Valves. F. C. Williams. *I.E.E., J.* 78. *pp.* 326–332, *March*, 1936.—This paper is concerned chiefly with a discussion of whether or not the anode stream of a thermionic valve produces a component of fluctuation voltage equal to that which would be produced by a metallic conductor of equal resistance at the kathode temperature. G. L. Pearson showed recently [see Abstract 1294 (1935)] that when the anode current is very small, the fluctuation voltage is equal to that in a metallic conductor of equal resistance at a temperature about half that of the kathode. In this paper it is shown that when the anode current is very small a familiar expression for the shot voltage assumes a form suggestive of a thermal-agitation voltage in a resistance at half the kathode temperature. This form is due to the dependence of anode current on kathode temperature when the anode is negative. Thus it would seem that Pearson's work does not necessarily prove that the anode stream is the seat of a thermal-agitation voltage: his results can equally well be interpreted as a shot-voltage effect, and such interpretation gives a direct explanation of why the relevant temperature is only half that of the kathode. AUTHOR.

2454. Approximate Calculation of Work of Emission of Electrons from Metals. E. H. B. Bartelink. *Physica*, 3. *pp.* 193–204, *April*, 1936. *In German.*—After a discussion of the methods hitherto employed for calculating the work of emission of electrons from metals a new method is given, an approximation being obtained to a solution of the Fermi relation. The result is a semiconvergent series development for the work of emission, depending upon the sixth root of β, the reciprocal of the atomic volume. Numerical calculation for the elements Li, Na, K, Rb and Cs gives values differing by about 40 % from the measured values, so that the method is not suitable for accurate quantitative calculation. A. W.

2455. Change of Work Functions at the Melting Points of Metals. H. Kurzke. *Zeits. f. Physik*, 98. 11–12. *pp.* 684–691, 1936.—From the electron theory of metals, Rother and Bomke show that the work function of a metal is smaller in the liquid than in the solid state. This is the reverse of the actual case. An attempt is made to account for this discrepancy by a change in the strength of the attachment of the "free" electrons to the atom at the melting point. [See following Abstract.] H. M. B.

2456. Normal Kathode Fall at the Melting Point of Bismuth. H. Kurzke. *Ann. d. Physik*, 25. 8. *pp.* 688–696, *April*, 1936.—An account was previously given of the behaviour of the normal kathode fall at the melting point of Sn, Pb and Hg. The present work gives similar results for Bi. By a combination of temperature, time and kathode-fall measurements the melting curve and the dependence of the kathode fall on the temperature of the kathode can be determined. In contrast with the results for Sn and Pb it is found that in the case of Bi there is a lowering of the kathode fall, and therefore of the work of emission, on passing from the solid to the liquid state. The drop is, for a normal kathode fall of about 160 V, on the average 2 V, which corresponds to a change of the work of emission of about 0·05 V. The results now obtained are related to other known phenomena at the melting point of Bi, such as the decrease of volume when melted and the increase of conductivity in the liquid state. [See preceding Abstract.]. A. W.

2457. Electron-Optical Observation of the Thermionic Emission of Ni in Cs Vapour. D. Schenk. *Zeits. f. Physik*, 98. 11–12. *pp.* 753–758, 1936.—The emission of a Ni wire in Cs vapour is studied by means of the electron microscope; a subsidiary electrode coated with CsOH is placed close to the kathode and Cs vapour distilled off by heat. The Cs layer on Ni proves to be very unstable (Ba layers are stable). It is shown that it is possible to activate a Ni surface with Cs in such a way that the microstructure of the surface is revealed, the most suitable temperature being 520° C. A comparison of the same Ni surface activated with Cs (at 520° C.) and with Ba (at 1000° C.) shows that more details of the surface structure are visible with Cs activation. [See Abstract 3703 (1935).] H. J. H. S.

2458. Emission Images of Thoriated Tungsten and Molybdenum. Part II. E. Brüche and H. Mahl. *Zeits. f. techn. Physik*, 17. 3. *pp.* 81–84, 1936.—The emissive properties of pure W have been investigated by the authors [see Abstract 1382 (1936)] but in practice the W is usually prepared in the presence of carbonaceous material ("carburisation"). With the aid of an electron microscope, the properties of carburised W and Mo are studied. It is found that a greater and more uniform emission is obtained with a lower reduction temperature than in the case of the pure metals. It is shown that carburisation lowers the reduction temperature of Th_2O, has no marked effect on activation or deactivation but profoundly modifies the manner in which Th is deposited. It also causes a complete reduction of the total Th which results in a greater and more lasting emission from the kathode. H. J. H. S.

***2459. Electron Microscope for Filaments: Emission and Adsorption by Tungsten Single Crystals. R. P. Johnson and W. Shockley.** *Phys. Rev.* 49. *pp.* 436–440, *March* 15, 1936.—A new and simple electron microscope is designed for small cylindrical filaments. Die marks are found to be prominent in the electron images of all drawn wires. The activation of thoriated W is studied. Electron emission from single crystals grown in drawn pure W filaments varies around the wire circumference and depends systematically on crystallographic direction. This variation of emission with crystallographic direction is more pronounced and complex when the filament is allowed to self-activate in Cs or K vapour. AUTHORS.

2460. Mobility of Potassium on Tungsten. R. C. L. Bosworth. *Roy. Soc., Proc.* 154*A*. *pp.* 112–123, *March* 2, 1936.—The surface migration

of films of K on W are studied over a wide range of concentrations and it is found that the diffusion coefficient rises while the associated activation energy falls with increasing concentration. From an extrapolation of the experimental results it is shown that the activation energy of diffusion for an infinitely dilute film should be 0·72 V. For films of the thickness corresponding to a monolayer this energy has been reduced to 0·29 V. This fall in the activation energy is a manifestation of the existence of a spreading force due to mutual repulsion of the adions. Values of this spreading force at different surface concentrations are calculated, and from them the effective dipole moment of the adions. In order to fit the experimental spreading forces it is necessary to assume either that the dipole moment falls with increasing concentration, being depressed in the monolayer to 1/8 of its initial value, or else that the adions become more and more diluted with adatoms as the concentration rises. On a dynamical theory these two views may mean practically the same thing. [See also Abstract 3199 (1935).] AUTHOR.

2461. Contact-Potential Measurements on Tungsten Filaments. D. B. Langmuir. *Phys. Rev.* 49. *pp.* 428–435, *March* 15, 1936.—Changes in contact potential of the surface of a W filament produced by varying the temperature and the amount of Th on the surface are measured. Both activated and deactivated thoriated W filaments showed an increasingly negative contact potential (increasing work function) with rising temperature, the activated surface having the larger rate of change. The difference between the temperature coefficients of activated and deactivated surfaces is $3 \cdot 3 \times 10^{-4}$ V/°C. Pure W shows a temperature coefficient of opposite sign, indicating a decreasing work function with increasing temperature. An anomalous effect at low temperatures is ascribed to reversible gas reaction. C. J. B. C.

***2462. Oxide Kathodes of Colloidal Structure. E. Patai and Z. Tomaschek.** *Kolloid Zeits.* 74. *pp.* 253–265, *March*, 1936.—A new electrophoretic method is described for the precision production of oxide kathodes of the alkaline earths. A colloidal solution of an alkaline earth carbonate in water is used, in which the kathode to be coated is immersed and the carbonate layer deposited by means of an electric current. A full investigation is described of the effects of concentration, current density, temperature and kathode-material on the properties of the layer. The mechanical properties of such layers are particularly good ; they are very adhesive and have a smooth surface and uniformly fine structure. A new method for exact temperature estimation is given. Microphotographs exhibit the superiority of the colloidal layers over layers produced by spraying. Richardson's constants were determined for some layers and the results are shown in a diagram. A. W.

See also Abstract 2326.

THERMOELECTRICITY.

2463. Permanent Thermoelectric Currents in Metallic Conductors. F. Odone. *N. Cimento*, 13. *pp.* 11–15, *Jan.*, 1936.—Continuing previous work [see Abstract 915 (1936)] it is shown that the thermal phenomena that are produced in a metallic circuit in which a permanent current is flowing do not modify the free energy in the conductor, but cause instead a modification of the energy in the surroundings, with which the conductor itself exchanges energy. C. J. B. C.

2464. Thomson Effect at Very Low Temperatures, and Absolute Scale of Thermoelectric Power. M. Sansoni. *N. Cimento*, 12. *pp.* 616–632, *Dec.*, 1935.—The e.m.f. E of a wire, with a fall of temperature along it, is measured at low temperatures and the thermoelectric power $e = dE/dT$ derived; this is plotted for various temperatures against the temperature T°K from about −250° C. to 50° C. The Thomson effect σ, is obtained from these curves since $\sigma = Tde/dT$; Cu, Ag, and Au have positive T Thomson coefficients at high temperatures becoming negative and having a minimum at about 80° K. Pb shows a critical point about 7·5° K, where the thermoelectric power becomes zero. This is the effect of the superconducting state and gives corresponding results when coupled with Zn. The results of alloys of various metals containing a small percentage of other metals are given, comparison being made with the metals alone. The absolute scale of thermoelectric power is explained and a table given for the values for tin and lead. H. M. B.

2465. Thermoelectric and Voltaic Properties of Normal and Abnormal Metallic Films. R. Deaglio. *Comptes Rendus*, 202. *pp.* 831–832, *March* 9, 1936.—When thin films of Au of order $m\mu$ thickness are obtained by kathodic sputtering, it is found that normal films showing a green transparency give zero voltage when placed in the following circuit—a gold lump/green film of gold/water/ a gold lump—, but show even 0·6 V if an abnormal blue or reddish film is used. Thus zero e.m.f. shows normality of films even when colour is not seen. If thick layers of Au are sputtered on to the ends of a glass plate with a film of Au joining them, then by heating one junction between layer and film to 70° C. and the other to 20° C., e.m.f.'s from 5×10^{-4} to 40×10^{-4} V are obtained. Thus the films are voltaically equivalent and thermoelectrically different from ordinary metal. H. M. B.

See also Abstract 2276.